Evaluating the developmental potential of the automotive industry in South Africa: A Product Space and Location Framework Approach

by

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Declaration

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Abstract

There has been and still is much controversy regarding the effectiveness of industrial policies to develop industries, but in the case of the South African automotive industry, the industry is regarded as being defined by industrial policies. Since the implementation of the first industrial policy program in 1995, the Motor Industry Development Programme (MIDP), the automotive industry has grown to become one of the most significant contributors to South Africa's GDP. The MIDP was followed by the Automotive Production and Development Plan (APDP) in 2013 and the revised APDP in 2021, for which the aim has been to develop the local automotive value chain. The South African Automotive Masterplan (SAAM) was developed as the automotive vision for 2035 but can only be realised if sufficient industrial policies supporting the plan's objectives are put in place.

Although the South African automotive industry is regarded as an example where industrial policy programs were mostly successful, industrial policymaking is still regarded as a "learn by doing" or a "doomed to choose" process. Therefore, it can be assumed that there is still a need for more decision support tools. Thus, this study aimed to evaluate how the Input-Output Product Space (IO-PS) framework and Location Determinants Evaluation Framework (LDEF) could support policy decision making by applying the frameworks to the South African automotive industry and what the strengths and the weaknesses of these frameworks are.

Firstly, the IO-PS framework was applied to the South African automotive value chain, and automotive body parts were identified as a possible development area. Secondly, the LDEF was used to determine the location success factors needed to make South Africa a viable location for manufacturing automotive body parts.

The output from the frameworks was evaluated, and it was concluded that the IO-PS supports decision-making in selecting opportunities with the highest probability of structural growth. However, it is not successful in identifying products that cannot be exported due to physical attributes. The LDEF was deemed to successfully guide the consideration of location-, market- and location interaction success factors, although the process of applying the LDEF is cumbersome and time-consuming. Other strengths and shortcomings were identified, and areas for future work were suggested.

Opsomming

Daar is ‘n geskiedenis van omstredenheid in verband met die sukses van nywerheidsbeleid vir ekonomiese ontwikkeling. In die geval van die Suid-Afrikaanse motorbedryf word die industrie geag as gedefinieer deur nywerheidsbeleid. Sedert die aanvang van die eerste nywerheidsbeleid program in 1995, die Motornywerheid-ontwikkelingsprogram (MNOP), het die industrie een van die groot bydraers tot Suid-Afrika se bruto binnelandse produk (BBP) geword. Die MNOP is gevolg deur die omvattende produksie- en ontwikkelingsplan vir die motorbedryf (APDP) in 2013 en die hersiene APDP in 2021. Die doel van die APDP is om ‘n meer gevestigde plaaslike waardeketting in die motorbedryf te skep. Die meesterplan vir die Suid-Afrikaanse motorbedryf (SAAM) was ontwikkel om die visie van die motorbedryf in Suid Afrika vir 2035 te definieer. Die visie kan slegs behaal word indien genoegsaam nywerheidsbeleide in plek gestel word om die doele van die plan te ondersteun.

In die geval van Suid-Afrika word die motorbedryf gekenmerk aan die sukses van nywerheidsbeleid programme, alhoewel die proses om nywerheidsbeleid te formuleer steeds beskou word as ‘n proses van “leer deur te probeer” en ook “gedoem om te kies”. Dit kan dus aanvaar word dat daar steeds ‘n behoefte vir besluit-steun-hulpmiddels is. Die doel van hierdie tesis was dus om te evalueer hoe die Inset-Uitset Produkruimte (IO-PS) raamwerk en ‘n raamwerk vir die evaluering van liggings bepalers (LDEF) toegepas kan word om beleidsbesluitneming te ondersteun deur die raamwerk toe te pas op die Suid-Afrikaanse motorbedryf en sodoende die sterk en swakpunte van hierdie raamwerke te identifiseer.

Die IO-PS raamwerk was toegepas op die Suid-Afrikaanse motorbedryf waardeketting. Hierdie toepassing het gelei tot die identifisering van die motorvoertuig bakwerk industrie as ‘n moontlike ontwikkelingsarea. Daarna was die LDEF gebruik om te bepaal watter ligging sukses faktore benodig word om die bakwerk industrie suksesvol in Suid Afrika te maak.

Nadat die raamwerke toegepas is, is die sukses van die raamwerke om nywerheidsbeleid besluitneming te ondersteun evalueer. Die gevolgtrekking was dat die IO-PS raamwerk wel steun kan bied om geleenthede met die meeste potensiaal vir ekonomiese groei te identifiseer. Die grootste tekortkoming van die raamwerk is dat dit blind was vir produkte wat nie uitgevoer kan word as gevolg van fisiese eienskappe van die produk. Die gevolgtrekking was gemaak dat die raamwerk vir die evaluering van liggingsbepalers suksesvol was om die proses te lei om ligging, mark en interaksie faktore te evalueer. Dit was egter ‘n omslagtig en tydrowende proses om die raamwerk toe te pas. Ander sterkpunte en swakpunte van die raamwerke is ook geïdentifiseer en verdere studies voorgestel.

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Glossary

AAAM	African Association of Automotive Manufacturers
AIS	Automotive Investment Scheme
APDP	Automotive Production and Development Programme
ASCCI	Automotive Supply Chain Competitiveness Initiative
BEA	Bureau of Economic Analysis
BEC	Broad Economic Categories
BIW	Body-in-White
CBU	Completely built units
CKD	Complete knock-down units
DFA	Duty-free allowance
DTIC	Department of Trade Industry & Competition
EC	Eastern Cape
ECI	Economic Complexity Index
EEV	Energy-efficient vehicle
EFTA	European Free Trade Union
EFTA	European Free Trade Association
EU	European Union
FDI	Foreign direct investment
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GVC	Global value chain
HS	Harmonised System
ICE	Internal combustion engines
IDC	Industrial development corporation
IDZ	Industrial Development Zone
IEC	Import-export complementation
IO	Input-output
IO-PS	Input-output Product Space
ISIC	Standard International Trade Classification
KZN	KwaZulu-Natal
LDEF	Location Determinant Evaluation Framework
MIDP	Motor Industry Development Plan
MNC	Multi-National Company
MOISA	Motor Industry Ombudsman of South Africa
NAACAM	National Association of Automotive Component and Allied Manufacturers
NAAMSA	National Association of Automobile Manufacturers South Africa
NIPF	National Industrial Policy Framework
Numsa	National Union of Metalworkers of South Africa
OE	Original Equipment
OEM	Original Equipment Manufacturer
PC	Passenger Car
PCI	Product complexity index
PI	Production Incentive
PS	Product Space
PTA	Preferential Trade Agreement
R&D	Research and development

RCA	Revealed Comparative Advantage
RFQ	Request for quote
RMI	Retail Motor Industry Organisation
SA	South Africa
SAAM	South African Automotive Masterplan
SACU	South African Customs Union
SADC	South African Development Community
SEZ	Special Economic Zone
SSA	Sub-saharan Africa
SVI	Small vehicle incentive
UN	United Nations
US	University of Stellenbosch
USA	United States of America
VAA	Vehicle Assembly Allowance
VALA	Volume Assembly Localisation Allowance
WTO	World Trade Organisation
UNIDO	United Nations Industrial Development Organization

Chapter 1

1 Introduction

The first chapter is an introduction to the reader, explaining the background and the rationale of the research (Section 1.1). The research design follows Section 1.2, which includes the problem statement, research aim, objectives, and research scope. Thereafter, the case study selection is elaborated upon (Section 1.3), followed by an explanation of obtaining ethical clearance for the project (Section 1.4). The first chapter ends with Section 1.5, which presents the structure and layout of the thesis.

1.1. Background and rationale

The broader South African automotive sector made up 6,4% of GDP in 2019, comprising 4% manufacturing and 2,4% retail. Component and vehicle manufacturing made up 27,6% of the manufacturing sector, making it the largest manufacturing sector in South Africa. The larger automotive sector's employment was 110 250 employees on average per month in 2019. The industry attracted large foreign investments from the seven OEMs present in the country and component suppliers, which constituted R7,3 billion and R3,5 billion, respectively, in 2019. The seven OEMs also made investment commitments of R40 billion over the next five years, and the component industry committed to sourcing R20 billion worth of components domestically over the next five years. (Lamprecht, 2020)

South Africa's footprint is small in the global automotive value chain as the country's global vehicle production market share was 0,69%, and South Africa ranked 22nd in terms of global vehicle production in 2019. However, the domestic industry is highly dependent on the international market to remain a significant contributor to the manufacturing sector in South Africa, which is evident in the fact that 64,1% of light vehicles (passenger cars and light commercial vehicles) produced in South Africa were exported. Also, the growth of vehicle exports was 10,2% year-on-year in 2019. (Automotive Industry Export Council, 2018)

Since SA became a democracy, considerable attention regarding industrial policymaking has been put on the manufacturing sector, especially the automotive industry. The programs and initiatives implemented were very successful in increasing the share of the industry in the global market, and the presence of seven major Original Equipment Manufacturers (OEMs) based in South Africa is also a testament to its success.

Although the South African automotive industry has been shaped by industrial policy and the MIDP is seen as one of the most successful industrial policy programs implemented in South Africa post-Apartheid (Flatters, 2005; Barnes and Black, 2013; Fotoyi *et al.*, 2016), the literature is in agreement that there is no set plan for creating and implementing industrial policy. Fotoyi et al. (2016) comment that there is "no blue-print for the design and implementation of industrial policy" Fotoyi et al. (2016), and Bam and De Bruyne (2019) state that policymaking is "fraught with challenges," which they at least partially attribute to a lack of adequate decision support tools. Rob Davies, former minister of the Department of Trade Industry & Competition (the DTIC), comments that the industrial policy process is a case of "learn by doing" and that the essence of industrial policies is how effectively they can be adapted to an ever-changing market (The dti, 2018). Therefore, industrial policy decision-making is a continuous process of learning by implementing as a country discovers what works in global and local environments. (Fotoyi *et al.*, 2016)

1.2. Research design

The research design elaborates on the need for decision-making tools for policymaking in the automotive industry and the proposed tools to support policymaking. Firstly, the problem statement is defined (Section 1.2.1), then the research aim and objectives (Section 1.2.2) and research scope (1.2.3) are discussed.

1.2.1. Problem statement

The South African automotive industry is defined by industrial policy programs implemented since 1961, which started with local content programs, followed by the MIDP in 1995 and the APDP in 2012. A revised APDP will replace the APDP in 2021 based on the South African Automotive Masterplan (SAAM), which is a guide to the envisioned automotive industry status in 2035. South Africa has made considerable progress in the automotive industry with policy programs, but the SAAM states that the vision for 2035 can only be realised with well thought out industrial policies (Black *et al.*, 2018).

Industrial policymaking is an iterative process, and policies need to consistently adapt to developments in different industries (The dti, 2018). Therefore, it is of value to consistently find new decision support tools for policy decision-making in the automotive industry. Two seemingly promising frameworks have recently been proposed which aim to support policy decision making – the input-output product space (IO-PS) framework (Bam and De Bruyne, 2019) and location determinants evaluation framework (LDEF) (Bam, De Bruyne and Schutte, 2020). However, these frameworks have not been extensively tested to determine their strengths and weaknesses for industrial policymaking in any industry, least of all the automotive industry. There thus exists a need to evaluate these frameworks and a potential opportunity to gain new insights regarding the optimal way forward for industrial policy in the automotive industry in South Africa.

1.2.2. Research aim and objectives

The primary aim of the research was to evaluate the use of the IO-PS framework and LDEF as decision-support tools for developing policies for industrial sectors in general and the automotive industry in South Africa in particular.

In order to evaluate how these frameworks can be used to support policy decision making, the frameworks were applied to the South African automotive industry. Therefore, the following objectives were identified:

1. Apply the IO-PS framework to the South African automotive value chain to understand where in the value chain opportunities for structural growth exist.
2. Use the IO-PS framework's output as input to the LDEF to determine if the framework could sufficiently support governments to develop policies to make South Africa a viable location for the suggested growth opportunity.
3. Lastly, the frameworks' application needed to be evaluated to determine if the frameworks effectively support policy decision-making.

The research objectives and the research questions are denoted in Figure 1-1.

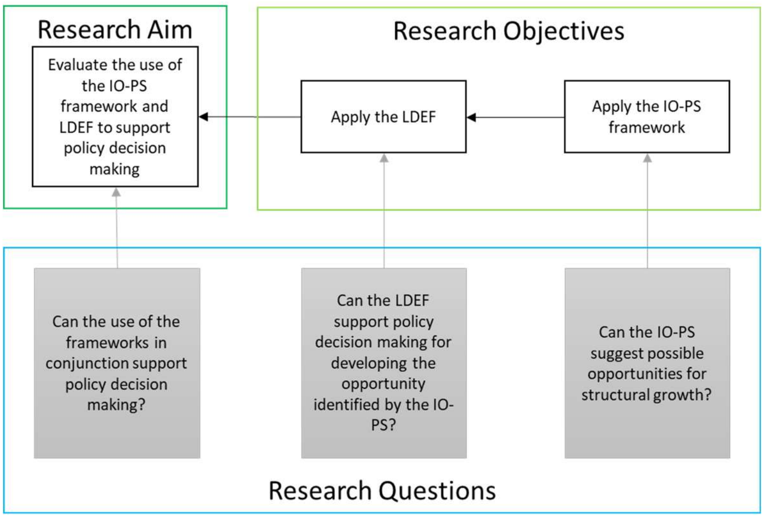


Figure 1-1 Research objectives and corresponding research questions

1.2.3. Research scope

This research is focused on applying the IO-PS framework and LDEF to the South African automotive industry to evaluate the use of these frameworks, thus assessing the potential of these frameworks for supporting industrial policymaking.

- **Need:** The process of policy decision making is still considered as a learn-by-doing process with numerous challenges which can be costly for developing countries; therefore, there is a need for tools to support policy decision making. Tools that seem to hold potential have been proposed, but they have not been thoroughly tested empirically.
- **Usefulness:** Guide future policy analyses in terms of understanding the advantages and disadvantages of using the novel frameworks. The case studies performed to test the frameworks hold the secondary benefit of potentially shedding new light on the optimal industrial policy setting for the focal case.
- **Contribution:** Using the output of the IO-PS framework as an input for the LDEF, which is a novel framework, to evaluate the use of these frameworks in conjunction as tools for policy decision making.

1.3. Case study selection

This study aims to assess whether the IO-PS framework and location determinants framework can be used to support industrial policy decision-making. Therefore, it is critical to select an applicable case study through which the frameworks can be assessed. The South African automotive industry, with a focus on the manufacturing aspect of the industry, was chosen for the following reasons:

- Globally the automotive industry, as part of the manufacturing basket, is considered as enabling inclusive growth by job creation, improving local value chains and advancing technology and consequently improving skills (Deloitte, 2018). As one of the world's largest manufacturing industries, the automotive industry has often been regarded as synonymous with industrialisation. Thus, globally countries have tried to promote their automotive industries with different industrial policy initiatives. (Black, Barnes and Monaco, 2018)
- Regarding the South African automotive industry:
    - The industry contributed 15,5% of South Africa's total exports in 2019 (Lamprecht, 2020), making the industry an essential contributor to GDP and securing considerable government attention.
    - The industry has been shaped by industrial policy programs, including the local content programs, MIDP and APDP. The launch of the SAAM, which defines the South African automotive industry's vision for 2035, states a need to design industrial policies to attain this vision.
- Regarding the IO-PS framework:
    - In order to find opportunities that could contribute significant complexity to South Africa's export basket, the country needs to have a low economic complexity index (ECI). South Africa had an ECI of 0,16 in 2018 compared to the top ten countries having an average ECI of 1,8 in the same year; South Africa ranked 59th according to the global economic complexity ranking

(OEC, 2020). Therefore, it is assumed that there is still an opportunity for more complex products in South Africa.
    - Sufficient trade data is necessary for the chosen country, and South African trade data is included in UN COMTRADE, The Center for International Data and the BACI International Trade Databases.
- Regarding the LDEF
    - Three types of activities can be analysed with the framework, being manufacturing, development and research. The firms in the automotive industry in South Africa are predominantly focused on manufacturing.
    - The LDEF assesses opportunities by comparing different countries' location factors from the perspective of footloose MNCs. Multinational OEMs and first-tier suppliers are footloose across the globe, control the global automotive industry, and greatly influence the South African automotive industry's success.
    - The LDEF assesses countries' location factors deemed necessary for success by MNCs. The South African automotive industry has been shaped by industrial policies that need to be updated regularly to ensure a viable business case for automotive MNC's.

1.4. Ethical approval

To determine what location determinants are essential for a specific economic activity to be viable in a specific location and to understand how South Africa is rated as a location for the activity identified by the IO-PS framework, it was necessary to conduct surveys. To conduct these surveys, ethical clearance needed to be obtained from the Faculty Ethics Screening Committee (FESC) from Stellenbosch University. Ethical clearance was obtained before any contact was made to possible participants in the survey.

1.5. Thesis structure

The layout of this document was structured to guide the reader through the application of the proposed frameworks by starting with a literature review of the industry and frameworks. The framework methodologies were discussed, followed by applying the frameworks, the policy implications deduced from the frameworks were discussed, and finally, the frameworks were evaluated. The thesis layout is presented in Figure 1-2, and a high-level description of the chapters are given below.

Chapter 2 – Literature review

This chapter aims to give an overview of the global automotive industry and how the South African automotive industry fits into the global industry. It also defines the global automotive value chain and considers the most widely known tool for analysing global value chains. Finally, the background and literature of the two frameworks used in this study are discussed.

Chapter 3 – Methodology

Firstly, the steps used to develop an automotive input-output value chain are discussed in this chapter, after which the process of applying the IO-PS framework is explained. Secondly, the methodology to apply the LDEF is discussed.

Chapter 4 – Input-output Product Space analysis

In this chapter, the generic automotive value chain is discussed and the output of the IO-PS framework. Finally, the activity chosen for further development is identified.

Chapter 5 – Location Determinants Evaluation framework

In this chapter, the results from applying the LDEF to the identified activity in Chapter 4 are presented, which include gathering information, setting the unit of analysis, market analysis, location analysis and interaction, and dynamic analysis. Finally, policy implications are discussed.

Chapter 6 – Discussion of frameworks

Chapter 6 considers the validity of both the IO-PS framework and the LDEF and the use of both the frameworks to support decision making when designing policies.

Chapter 7 – Conclusion and recommendations

This chapter concludes the research by discussing how the project fulfils the research aim. It also summarises each chapter with regards to how it supported the process of concluding the research aim. Lastly, this chapter provides recommendations for future work.

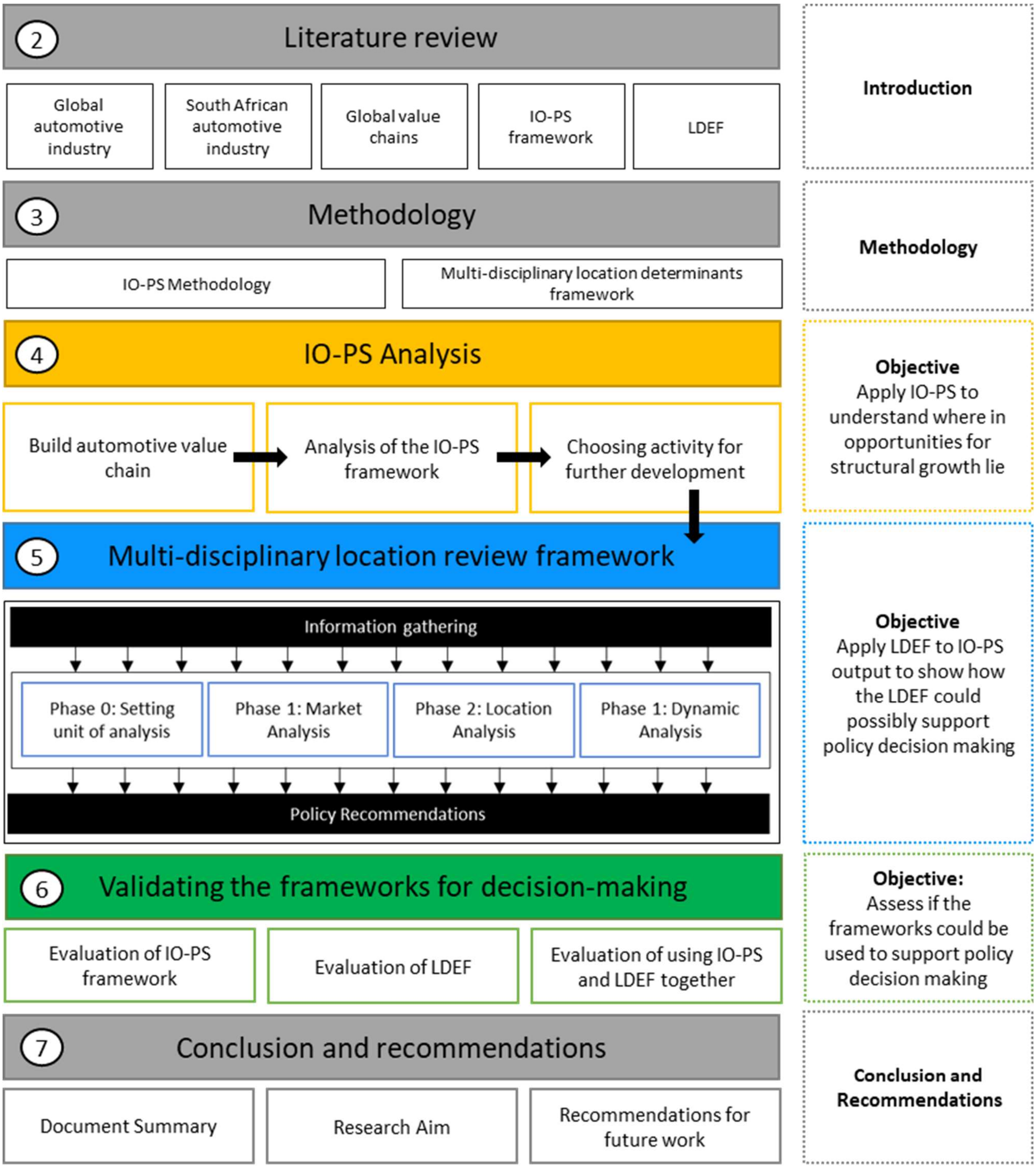


Figure 1-2 Thesis layout and corresponding objectives

Chapter 2

2 Literature Review

The first chapter described the need for decision support tools for industrial policymaking. In order to fulfil this need, the objective of assessing two frameworks for policy decision making was developed. It was determined that the South African automotive industry would be analysed using these frameworks as the industry is critical to the South African economy, and industrial policy programs define the industry.

This chapter provides an overview of the global (Section 2.1), the South African automotive industry (Section 2.2) and the application of the global value chain analysis lens to the automotive industry (Section 2.3). The two frameworks, IO-PS (Section 2.4) and LDEF (Section 2.5), were also discussed to provide a basis for understanding these frameworks' applications.

2.1. Global automotive industry

The global automotive value chain is one of the world's largest industries; the industry represents potential economic development and structural growth for developing and developed countries alike. It also attracts large sums of foreign investment and supports upstream (i.e. steel and plastic), downstream (i.e. finance and insurance and used car market) and adjacent industries (finance and legal) (Klink *et al.*, 2014). Therefore, governments have spent considerable time and money supporting and developing the industry within their respective jurisdictions. This section describes the structure of the global automotive industry (Section 2.1.1.), discusses global automotive production (Section 2.1.2.) and the future of the global automotive industry (Section 2.1.3.).

2.1.1. The structure of the global automotive industry

The global automotive industry is known for its interdependent relationship between the automotive stakeholders and governments, where governments depend on economic development from the automotive industry and the industry depends on incentives to make manufacturing in a specific country viable (Deloitte, 2018). The global automotive industry can be divided into three primary industry tiers (Deloitte, 2018):

1. **Original Equipment Manufacturers (OEMs)** – Responsible for designing, assembling and marketing the final automotive product. In some cases, components are manufactured by the OEM. OEMs include, amongst others, Volkswagen, BMW, Toyota. Many components are sourced from first-tier suppliers, usually chosen according to stringent requirements or historical relationships.
2. **First-tier suppliers** – Directly supply components or systems to OEMs according to the OEMs' requirements. Lower-tier suppliers supply inputs for manufacturing these components or systems. Examples of first-tier suppliers are Bosch and Continental.
3. **Remaining tiers** – These tiers supply inputs, smaller parts and raw materials to downstream tiers. These suppliers may also feed into other industries and are not necessarily confined to the automotive industry. These tiers include, amongst others, aluminium and steel producers.

The value addition of OEMs, first-tier suppliers and the supplying tiers are estimated to contribute approximately 20%, 30% and 50% to the value of the final product, respectively (Figure 2-1) (Black, Barnes and Monaco, 2018).

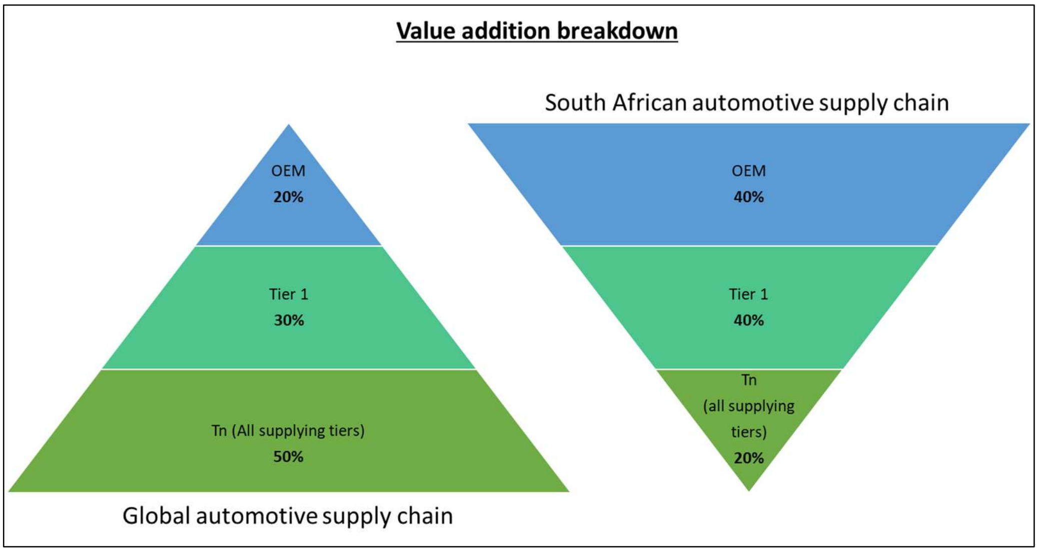


Figure 2-1 A comparison of the global and South African value addition breakdown (Black, Barnes and Monaco, 2018)

2.1.2. Global automotive production

The automotive industry produced just under 92 million vehicles, which is 5% down from 2018. It can be seen in Figure 2-2 that the global industry grew from 2009, recovering from the financial crisis and growing to 72 million units produced globally in 2017, but declining in 2018 and 2019. Lamprecht (Lamprecht, 2020) attributes the reduction of units manufactured to the global trade tensions and the possibility of tariff increases. (Lamprecht, 2020) China, Japan and the USA were the top three producers of passenger and commercial vehicles in 2019 (Figure 2-3) (OICA, 2021). China was the most significant contributor to global production in 2019, with a total of 25,7 million units (passenger and commercial vehicles), which can be attributed to the high domestic demand for passenger vehicles (Lamprecht, 2020). The top five producers of passenger cars, including China, Japan, Germany, India and South Korea, contributed to more than 60% of global vehicle production for 2019. Passenger vehicles contribute to 73% of global automotive production, where commercial vehicles make up the rest. Commercial vehicles' production is dominated by the USA, while China, Mexico and Canada also make considerable contributions to commercial vehicle production (Figure 2-4). (OICA, 2021)

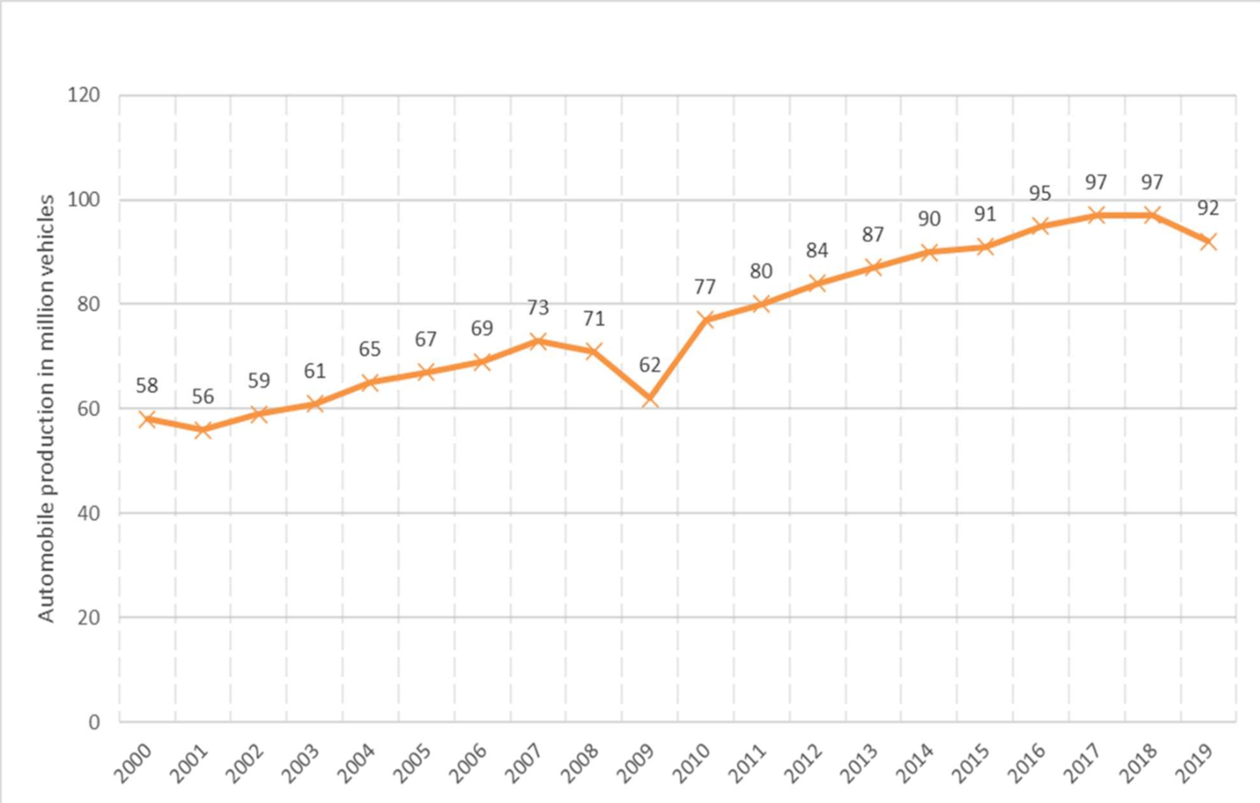
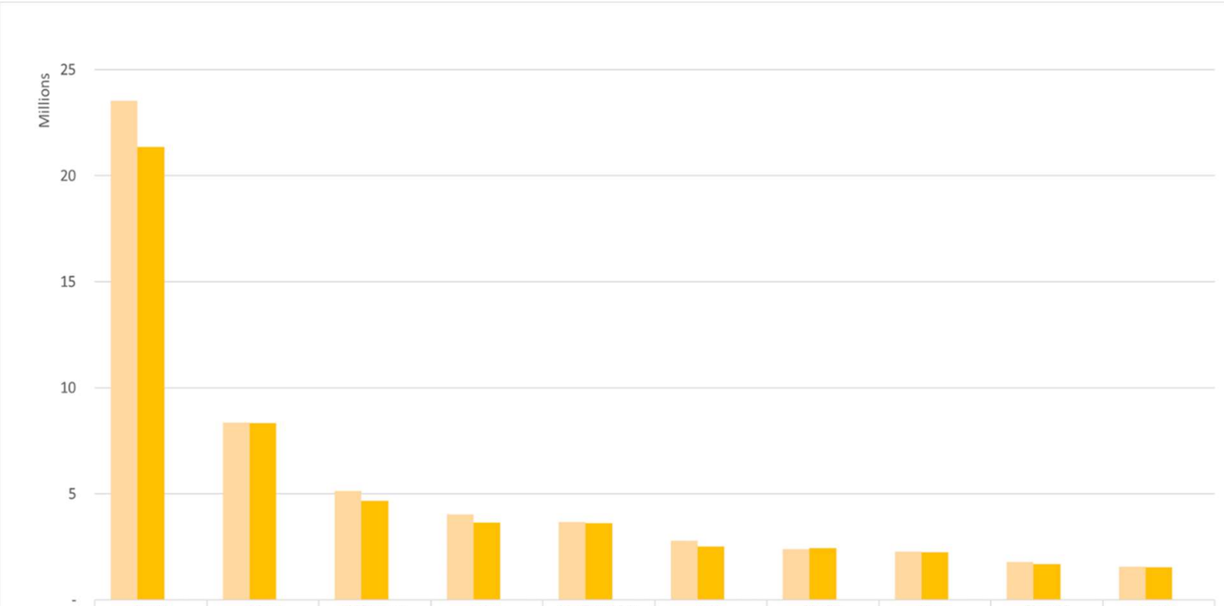
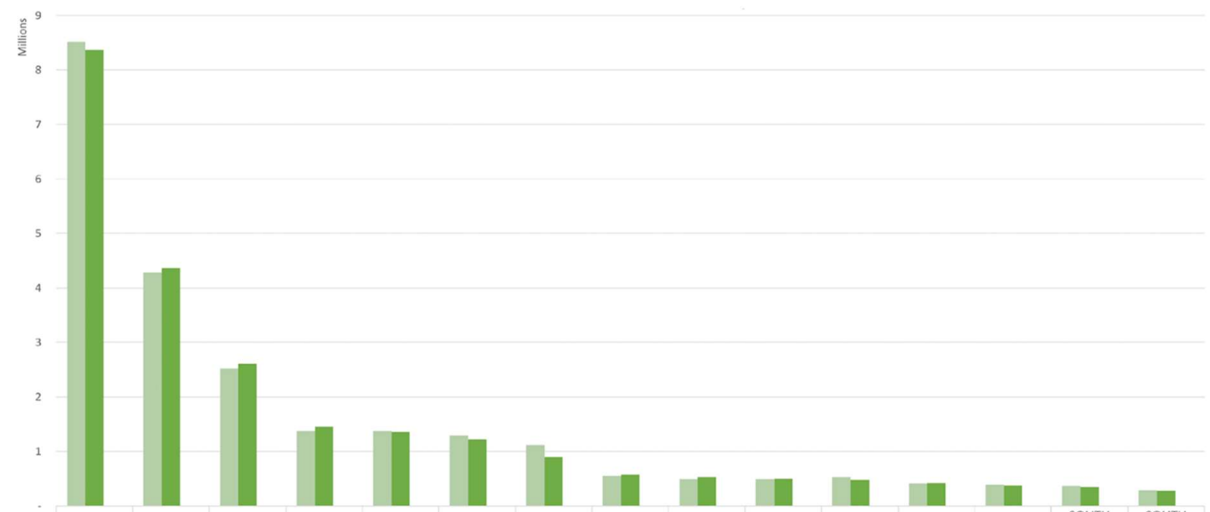


Figure 2-2 Estimated worldwide automotive production (passenger and commercial vehicles) from 2000 - 2019 (Please note Audi, BMW, Jaguar Land Rover, Mercedes, Scania and Daimler Trucks data are not reported according to the source) (OICA, 2021; Statista, 2021)



	CHINA	JAPAN	GERMANY	INDIA	SOUTH KOREA	USA	BRAZIL	SPAIN	FRANCE	RUSSIA
2018	23 529 423,00	8 359 286,00	5 120 409,00	4 032 481,00	3 661 730,00	2 785 164,00	2 387 967,00	2 267 396,00	1 772 641,00	1 563 747,00
2019	21 360 193,00	8 328 756,00	4 661 328,00	3 623 335,00	3 612 587,00	2 512 780,00	2 448 490,00	2 248 019,00	1 675 198,00	1 523 594,00
Difference	-9,2%	-0,4%	-9,0%	-10,1%	-1,3%	-9,8%	2,5%	-0,9%	-5,5%	-2,6%

Figure 2-3 Global passenger car units produced in 2018 and 2019 according to the top 10 countries (OICA, 2021)



	USA	CHINA	MEXICO	CANADA	JAPAN	THAILAND	INDIA	SPAIN	FRANCE	BRAZIL	TURKEY	POLAND	ITALY	SOUTH KOREA	SOUTH AFRICA
2018	8 512 747	4 279 773	2 519 758	1 369 898	1 370 308	1 290 679	1 110 328	552 169	495 123	493 051	523 689	410 199	389 136	367 104	289 757
2019	8 367 239	4 360 472	2 604 080	1 455 215	1 355 542	1 218 456	892 682	574 336	527 262	496 498	478 602	422 966	373 298	338 030	283 318
Difference	-1,7%	1,9%	3,3%	6,2%	-1,1%	-5,6%	-19,6%	4,0%	6,5%	0,7%	-8,6%	3,1%	-4,1%	-7,9%	-2,2%

2018 2019 Difference

Figure 2-4 Global commercial vehicle production of 2018 and 2019 (top 15 countries)

2.1.3. The future of the global automotive industry

When looking at global trends, the factor that is considered to have the most significant effect on the industry is moving toward more environmentally conscious production processes and vehicles. The main reasons for this are the increasing cost of fossil fuels and more strict emission policies in developed countries. According to Black *et al.* (2018), the effect of these environmental pressures will lead to lighter and more easily recycled vehicles, and the size of internal combustion engines (ICE) will decrease and will be more fuel-efficient. Other changes are using alternative materials for body structures and replacing the ICE with other technologies, such as electric engines and hydrogen fuel cells. The time it will take to transition to alternative technologies and materials are still uncertain, but it is projected that energy-efficient vehicles (EEVs) will contribute to 35% of the global automotive market share by 2040 (Black *et al.*, 2018).

Other factors which will affect the demand for vehicles are (Black *et al.*, 2018):

- Customer requirements are changing; developed economies demand more technology forward, energy-efficient and safer vehicles, where developing countries are demanding smaller and cost-efficient vehicles.
- Due to customer requirements changing, it is predicted that OEMs and first-tier suppliers will move towards developing countries where more growth opportunities lie.
- The development of self-driving/autonomous vehicles is expected to lead to higher demand for in-vehicle infotainment and may also change the prospect of car ownership, with customers potentially opting for self-drive taxis rather than owning a car.

Finally, due to the Covid-19 pandemic, it is forecasted that the global new vehicle sales for 2020 will be just over 70 million, that is, 18,5 million light vehicles less than initially predicted for the year. The predicted drop in global demand for 2020 is approximately equal to the combined sales expectations of the UK, Japan, and the USA in the same year. Consumers are concerned about their financial situation in the coming years due to the recession caused by the pandemic, and consequently, consumers are planning to delay new vehicle purchases. Although the full impact of the pandemic and the length of recovery are still uncertain, there is a need for all industry stakeholders to work together to ensure the industry recovers from this crisis. (Vitale, Bowman and Robinson, 2020) The South African automotive industry will be discussed in the next section.

2.2. South African automotive industry

Although the South African automotive industry has a small footprint in the global automotive industry, it is a significant contributor to the country's GDP and is seen as South Africa's most important manufacturing industry. The industry value chain contributes to a third of the domestic manufacturing value add (Lamprecht, 2020), making the industry a focus point for cross-industry spillovers and hence a focus point for industrial policy. In this section, the current state of the South African automotive industry is discussed (Section 2.2.1), the industrial policy programs implemented since 1961 (Section 2.2.2) and the organisational structure of the automotive industry (Section 2.2.3), which gives substantial support to stakeholders are discussed.

2.2.1. The current state of the South African automotive industry

Vehicle sales in South Africa are correlated with the economy's performance, and during 2019 the pressure on disposable income was evident in the contraction of light vehicle sales. Light vehicles, including passenger cars and light commercial vehicles, contribute 66,2% and 28,6% respectively to the market, were down by 2,7% and 4% from 2018 to 2019. Although the market for light vehicles contracted, the demand is still there for entry-level vehicles, small utility vehicles and crossovers. In 2019 South African passenger car consumers were offered 46 brands and 2507 model derivatives, and for light commercial vehicles, 28 brands and 526 model derivatives were available, making the South African light vehicle market one of the most competitive in the world. It can be seen from the key performance indicators (Table 2-1) that new vehicle sales and units imported were down by 2,8% and 0,5%, respectively, which is indicative of the struggling domestic economy even before the impact of the Covid-19 pandemic. The vehicle and component production as a percentage of manufacturing output was also down by 2,3% but still contributed 27,6% to the manufacturing industry. (Lamprecht, 2020)

Table 2-1 Key performance indicators from 2018 to 2019 adapted from the Automotive Export Manual (Lamprecht, 2020)

Indicators	Performance		
	2018	2019	Change
Broader automotive industry contribution to GDP	6,8%	6,4%	-0,4%
Vehicle and component production as % of South Africa's manufacturing output	29,9%	27,6%	-2,3%
Average monthly employment by vehicle manufacturers	29 855	30 250	1,3%
Total South African new vehicle sales (units)	552 227	536 611	-2,8%
Total South African vehicle production	610 060	631 983	3,6%
South Africa's vehicle production as % of Africa's vehicle production	54,3%	57,2%	2,9%
South Africa's global vehicle production market share	0,64%	0,69%	0,1%
Vehicle ownership ratio per 1 000 persons	176	179	1,7%
Automotive export value as % of total South African export value	14,3%	15,5%	1,2%
Export destinations	155	151	-2,6%
Total South African vehicle exports (units)	351 139	387 125	10,2%
Value of vehicle exports (billion rands)	127,4	148	16,2%
Value of automotive component exports (billion rands)	51,3	53,7	4,7%
Import destinations	25	25	0%
Light vehicles imported	292 197	290 624	-0,5%

The total units exported increased by 10,2%, and the value of vehicle exports increased by 16,2%; this could be due to higher-value vehicles being exported or increased export prices, but it could also be due to exchange rate fluctuations. South African light vehicle production has been increasing year on year since 2016 (Figure 2-5), and so has exports since 2017, which indicates that the increased production is absorbed by exports and not by local demand. The export market for light vehicles produced in South Africa enables the OEMs to increase production and reach efficient returns to scale. South Africa's top three trade partners for light vehicles are Germany, Belgium and the United Kingdom, which accounted for R57,4-, R17,5- and R15,8 billion in 2019, respectively. (Lamprecht, 2020)

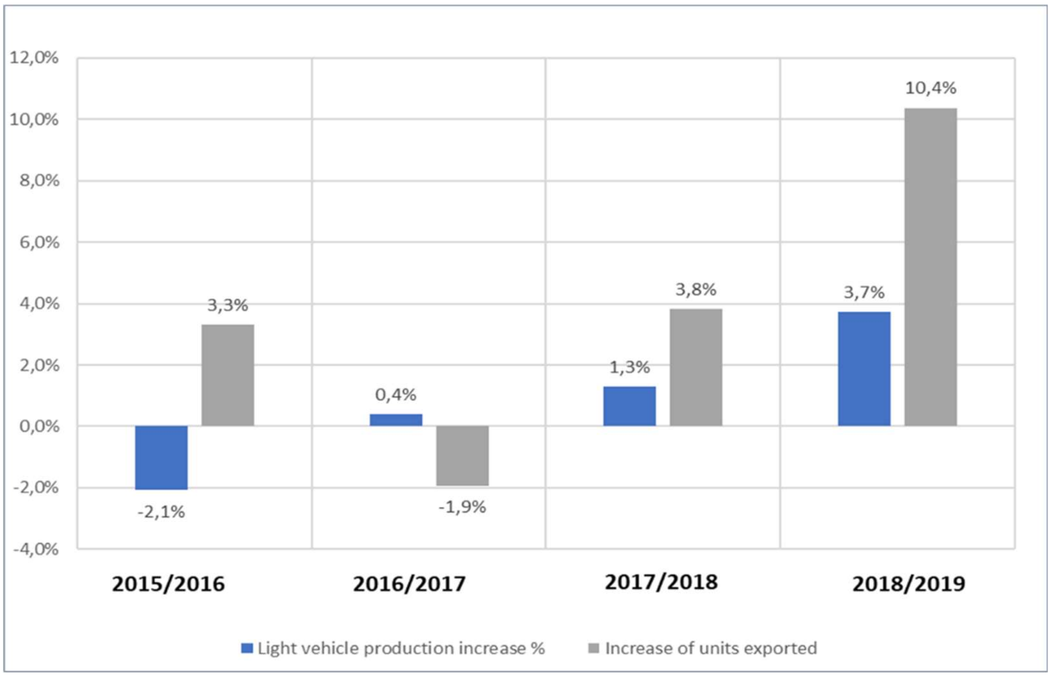


Figure 2-5 Light vehicle production versus units exported from South Africa data obtained from the Automotive Export Manual (Lamprecht, 2020)

In order to develop an export market for South African produced vehicles, the South African government introduced several industrial policy programs, which will be discussed in the next session.

2.2.2. Industrial policy in the South African automotive industry

There has not been consensus on a formal definition for industrial policy, but most define it as a policy that is targeted towards a specific industry, specifically in the manufacturing sector. Thus there is an emphasis on the selectivity towards an industry (Chang, Andreoni and Kuan, 2013). Industrial policies aim to stimulate structural change towards more optimal production activities in a specific industry (Hausman, Dani and Sabel, 2008), thus, to increase the production of more complex, high-value products in the most effective way (The dti, 2018). Although industrial policies are aimed at one specific industry, it is anticipated that benefits will spill over to other industries in the economy (Chang, Andreoni and Kuan, 2013), which will result in greater overall welfare and production capabilities in the economy (The dti, 2018).

Regarding industrial policy in the global automotive industry, developing countries used import-substituting industrialisation (ISI) practices and local content programmes to develop their automotive manufacturing industries during the second half of the 20th century. At this time, the industry was defined by the high proliferation of vehicles due to preferential tariffs. Later in the twentieth century, ISI practices were reduced, and developing countries still relied on industrial policies to promote their automotive industries. These countries include, among others, Brazil, Thailand, Turkey and South Africa. These developing countries' automotive industries made a considerable contribution to their GDP, but these countries were small contributors to the total global vehicle production, which was dominated by North America, Western Europe and Japan. The state of the automotive industries of developing countries worsened further with the removal of high tariffs and local content programmes as requested by the World Trade Organisation (WTO) aiming for trade liberalisation in the early nineties. (Barnes and Morris, 2008)

Since 1961 the South African automotive industry has been shaped by industrial policy, and the industry has grown significantly. The first program implemented was the local content programs, followed by the MIDP in 1995, which the APDP replaced in 2013. A revised APDP will be implemented in 2021, with the SAAM as a guideline for the industry. These policy programs and automotive plan are further discussed in the following sections.

2.2.2.1. Local content programs

Ford and General Motors were the first to establish assembly plants in South Africa in the 1920s, attracted by the domestic market's expected protection in the form of import tariffs. In the following years, components, mainly batteries, glass and tyres, were manufactured locally, but local content remained low, and by 1985 local content was less than 20%. The reason for this was because the components manufactured by the 94 registered component manufacturers were for aftermarket sales. (Barnes and Kaplinsky, 2000a). In 1958 a vehicle's weight consisted of 17% of local components (Damoense, 2001). By 1960 the automotive industry made up 15% of total imports, that with the anticipated growth potential for the industry, low local value-added and externalities to other sectors enticed the government to develop six local content programs which would run from 1960 to 1995 (Barnes and Kaplinsky, 2000a). A summary of the local content programs can be seen in Table 2-2.

Phase I to III

From 1961 South Africa followed in the footsteps of, among others, India and Brazil by implementing the import-substituting industrialisation (ISI) paradigm, which involved tariffs, import permits, and local content requirements, which came in the form of a local content program, in order to create "assembler-component linkages." In combination with international sanctions in the late 1970s due to Apartheid, the ISI paradigm excluded the South African automotive industry from global restructuring developments. (Barnes and Morris, 2008)

Phase V to VI

By the late 1980s, the highly protected South African automotive industry was inefficient, due to extreme proliferation, and being "highly inward-oriented" (Black, 2009) and to meet the trade liberalisation requirements by the WTO, the start of reduced protection of the industry was introduced in the next phase of the local content program (Phase VI) in 1989 (Black, 2009).

Table 2-2 Summary of the local content programs (A. L. Alfaro *et al.*, 2012)

Local content programs	**Key Elements**	**Outcome**
Phase I to III (1961 – 1980)	● Minimum domestic content requirement with an incentive scheme for OEMs for compliance ● Incentives came in the form of a highly protected industry, tax incentives and permits	● Increased number of component manufacturers and OEMs established in South Africa ● Increase of proliferation of model variants
Phase V to VI (1981 – 1994)	● Export promotion ● Excise duty rebate for the value of domestic content of locally produced vehicle or component ● Export credits could be traded among manufacturers	● Significant increase in the export of vehicles and components ● The proliferation of model variants still increased ● The decline of the number of OEMs (7)

A distinguishing factor of an automotive industry with high levels of protection is the high proliferation of model variants, and although there were only seven OEMs in South Africa by the late 1980s, they produced 14 different models; by 1987, the models increased to 22, and by 1993, the seven OEMs produced 34 model variants. Due to the high levels of proliferation and low sales levels due to a slow market, economies of scale could not be reached, causing the cost of production to be exceptionally high. Realising these issues and considering the objective to take part in the global automotive industry, the MIDP was developed and implemented after Phase VI of the local content program. (Barnes and Kaplinsky, 2000a)

2.2.2.2. Motor Industry Development Plan

The Motor industry development plan (MIDP) followed the local content program in 1995 after the first democratic elections, and the dti launched revisions of the plan in 1998 and 2002. The MIDP is seen as the most prominent industrial policy program thus far due to the effectiveness of establishing an incentive structure, the size of the industry impacted, and the cost of implementing the program. (Barnes and Black, 2013)

The main objectives of the MIDP were enhanced international competitiveness, increased foreign investment, and rationalising the automotive industry to grow the economy (Damoense, 2001). Other objectives were (Damoense, 2001):

- sustainable employment levels in the industry,
- high-quality, affordable vehicles,
- increasing exports and improving trade valance.

Key features of the MIDP include (Damoense, 2001):

1. Local content regulations were removed, but an indirect implication of the import-export complementation (IEC) regime required certain local content levels in real value terms.
2. Gradually reduced support for the automotive industry, which included tariffs on completely built units (CBUs) and completely knocked down units (CKDs), were to be reduced to 40% and 30% respectively over eight years from the start of the MIDP.
3. Incentive schemes in the form of the IEC regime, duty-free allowance (DFA), and the small-vehicle incentive (SVI) scheme were available for qualifying OEMs.

The most significant impact of the MIDP was the growth of automotive exports, which grew from R4,2 billion in 1995 to R86,9 billion in 2012, which translates to 12,1% compound annual growth. The export growth can be attributed to the IEC regime under Phase VI and MIDP, reduced protection, low domestic demand and weak rand stints during the period. The aim of implementing the IEC regime was to increase component production quantities in order to reach economies of scale. However, instead, the IEC scheme was used by firms to earn credits by exporting small investment 'peripheral' (i.e. automotive leather and catalytic converters) components to be able to import low volume models into the market. This led to ten component categories making up more than 70% of component exports; these included, among others, catalytic converters, engine parts and silencers/exhausts. The export of components increased from R3,3 billion in 1995 to R36 billion in 2012. (Barnes and Black, 2013) The other impacts of the MIDP are listed below (Barnes and Black, 2013):

- The reduction of tariffs led to increased imports of light vehicles, where imports accounted for less than 2% of vehicle sale in 1990 and increased to 58,1% by 2012.
- Since implementing the MIDP, there has not been a significant improvement regarding local content percentage, but the increased production of vehicles for exports supported the component manufacturing industry in a less protected environment.
- The inflow of foreign direct investment (FDI) during the MIDP was moderate, and most of the FDI inflows were directed to purchase ownership.
- The employment levels were mainly sustained in the industry, with employment being 104 100 in 1995 and 100 159 in 2012. The increase of labour due to the increased exports of labour-intensive components (e.g. automotive leather and wiring harnesses) offset the decrease of employment due to the industry's rationalisation, automation and outsourcing of some activities.

Although the MIDP ensured a more globally integrated industry, there were apprehensions towards the plan; these included compliance with the WTO subsidy requirements and distortions of the MIDP created by how the "materials-inclusive" (Barnes and Black, 2013) export-based benefits were calculated. Therefore, the

APDP aimed to replace the MIDP was to overcome "unintended consequences" and comply with WTO requirements. (Barnes and Black, 2013)

2.2.2.3. Automotive Production Development Plan (APDP)

The APDP is focused on production capabilities, where the MIDP's objective was the integration of the industry into global value chains (A. L. Alfaro *et al.*, 2012). The APDP is an incentive scheme and is characterised by four pillars, which include import duty, the production incentive (PI), vehicle assembly allowance (VAA) and the automotive incentive scheme (AIS).

Import duty

The import duties of 25% and 20% placed on light vehicles and original equipment components, respectively, is to provide protection to domestic vehicle production and to incentivise the industry under the APDP regime. Preferential agreements have been made for EU vehicles for which import tariffs are 18%. (Automotive Industry Export Council, 2018)

The production incentive (PI) factor

The PI factor is an incentive available for qualifying manufacturers of raw materials or subcomponents (*Amended APDP Regulations*, 2016). The current PI factor is 10% of manufacturing value-add (MVA) which is any value added to raw materials or subcomponent until it is a final product ready for consumption, i.e. vehicle or component sold to the domestic market or exported. The incentive is received in the form of duty-free import credits. Thus, the higher the MVA, the higher the PI value would be, which equates to higher duty reductions. The PI mechanism aimed to increase localisation and develop the value chain, but since the implementation of the APDP in 2012, the average of local parts in assembled vehicles decreased from 46,6% to 38,7% in 2016. (Venter, 2019)

The Vehicle Assembly Allowance (VAA)

The VAA required light motor vehicle OEMs to assemble a minimum volume of vehicles in South Africa, and credits are earned according to the wholesale value (ex-factory vehicle price) of the vehicles being assembled, irrespective of local content used. Thus, the higher the selling price of a vehicle, the higher the duty write-off would be; hence OEMs selling high-value vehicles relied only on VAA for their duty accounts and did not need the PI and consequently did not need to focus on localisation. Therefore, the VAA is partly blamed for the decline of localisation during 2012 and 2016; still, the VAA mechanism ensured a sustained local assembly base and has shown some growth. (Venter, 2019)

Automotive Incentive Scheme (AIS)

The AIS is a non-taxable cash grant and is the first cash-based incentive for the South African automotive industry, intending to motivate investments by OEMs and component manufacturers in the domestic industry's productive capacity. Light vehicle manufacturers can qualify for 20%, and component manufacturers and tooling companies can qualify for 25% of the value of investments made in productive assets. When companies meet specific performance criteria, an additional 5% or 10% grant can be earned.

The decrease of local content was partly blamed on the VAA calculation, but another factor influencing the outcome of the APDP is the slow growth of the South African economy. Thus fewer cars are being imported, resulting in smaller duty accounts and less motivation to increase PI and VAA for rebates and consequently reduced efforts to improve local content (Venter, 2019). These factors were considered when developing the revised APDP, but there was a need for a long-term plan for the automotive industry before post-2020 policies could be developed, which initiated the SAAM, which is discussed next.

2.2.2.4. The South African Automotive Masterplan (SAAM)

The South African Automotive Masterplan (SAAM) sets out the vision, main objectives and a strategic framework for an optimally developed automotive industry from 2020 to 2035 (Black *et al.*, 2018). The SAAM is a strategy to develop the automotive industry in line with the presidential 9-Point Plan and the National Development Plan (NDP) (The dti, 2018). The vision for the SAAM (Black et al., 2018):

"*A globally competitive and transformed industry that actively contributes to the sustainable development of South Africa's productive economy, creating prosperity for industry stakeholders and broader society.*"

With this vision in mind, a global industry analysis was conducted, and six pillars for the SAAM were developed. These pillars include local market optimisation, regional market development, localisation, infrastructure development, industry transformation and technology and associated skills development (Figure 2-6). The basis of this plan lies in the condition that effective strategic automotive, industrial policies will be implemented to realise the vision. (Black et al., 2018)

In order to reach the vision, the following key objectives were identified (Black *et al.*, 2018):

1. Grow South African vehicle production to 1% of global output
2. Increase local content in South African assembled vehicles to up to 60%
3. Double total employment in the automotive value chain
4. Improve automotive industry competitiveness levels to that of leading international competitors
5. Transformation of the South African automotive industry through
    a. the employment of Black South Africans,
    b. upskilling of black employees,
    c. empowerment of dealerships and authorised repair facilities,
    d. and substantially increasing the contribution of black-owned automotive component manufacturers within the automotive supply chain
6. Deepen value addition within South African automotive value chains

The masterplan was created with comprehensive industry inputs to attain a transparent and attainable plan which industry stakeholders would support. The SAAM was intended to be used as a guideline for policymakers and decision-makers to base policy decisions on to ensure the vision is realised in 2035.

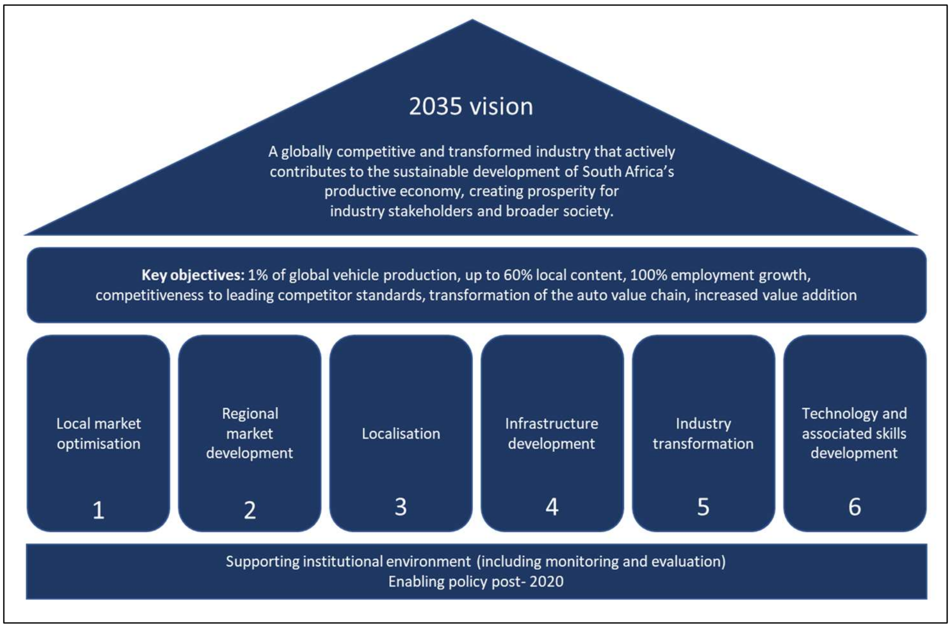


Figure 2-6 Vision, objectives and strategic implementation pillars of the SAAM for 2035 (Black *et al.*, 2018)

2.2.2.5. The revised Automotive Production Development Plan (APDP)

The revised APDP was developed based on the strategic framework and objectives set out in the SAAM, focusing on localisation and increased employment, which should realise if the desired localisation levels are reached. Therefore, the fundamental changes are the duty offset mechanisms, which have been made in consultation with OEM stakeholders. The current VAA system will be replaced by the Volume Assembly Localisation Allowance (VALA) system with the PI benefit level changed to 12,5% (from 10%) of value addition for qualifying component manufacturers not supplying to local OEMs. Therefore, incentivising the component manufacturers to develop and broaden their markets outside local OEMs. (Davies, 2018)

Revised APDP: Volume assembly localisation allowance (VALA)
The VALA mechanism will be implemented on a phased basis from 2021 to 2026. It is calculated by subtracting the value of imported content from the locally-assembled vehicle's wholesale price and multiplying the value by the applicable VALA percentage. This percentage will be 40% from 2021 and will be adjusted to 35% over the course of time. Thus, OEMs will still be incentivised for assembly but not for imported parts and components being locally assembled. (Venter, 2019)

The DTIC and relevant stakeholders will develop the plan for implementing the revised APDP (Davies, 2018). The DTIC is responsible for developing industrial policies for the automotive industry and also developing the action plan for these policies. In order to realise these plans, the automotive industry relies on supporting departments and institutions, which will be discussed in the following section.

2.2.3. The institutional structure of the South African automotive industry

In order to create a basis for industrial policies for the country as a whole, the National Industrial Policy Framework (NIPF) was launched in 2007, which focused specifically on manufacturing as a key driver for balanced development. The Industrial Policy Action Plan (IPAP) was launched in the same year to bring life to industrial policies set out in NIPF. The IPAP outlines the strategy for industrial policy, including timelines, action plans, and provides an economic analysis of domestic and global markets. The plans and policies set out in the IPAP were focused on nine sectors, of which the automotive industry received the most focus in the form of the Motor Industry Development Plan (MIDP) and later the APDP (Fotoyi et al., 2016). The Department of Trade Industry and Competition (the dtic) develops and manages the IPAP and launched the tenth version in 2018. Also, note the dtic was established in June 2019 when the Department: Economic Development (EDD) was incorporated into the Department of Trade and Industry (the dti) (SA Government, 2021). In this study, the dti and the dtic will be used interchangeably depending on the source.

The mission of the dtic, among others, is to align economic policies and the government's political and economic objectives. The structure of the dtic in Figure 2-7 represents departments of the dtic specific to the automotive industry applicable for this study. In realising the vision of a dynamic industrial and globally competitive South African economy, relating to the automotive industry, the industrial development and financial assistance departments exist. The NIPF falls under the industrial development department and, as mentioned earlier, is a policy framework to realise the industrialisation objective of government by aligning public and private sector targets toward this objective (the DTIC, 2014).

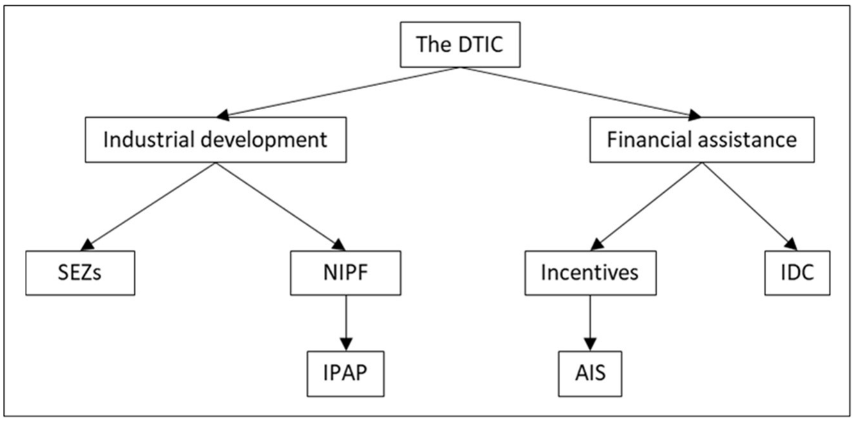


Figure 2-7 Structure of the DTIC confined to the automotive industry for this study

The financial assistance department is responsible for incentives, which, specific to the automotive industry, comes in the form of the AIS, which is one of the four pillars of the APDP. The Industrial Development Corporation (IDC) is a governmental institution and falls under the dtic management. The institution was established with economic growth and industrial development as the key focus areas. (the dtic, no date a)

As mentioned earlier, the DTIC sets out the action plan of industrial policies; they also have supporting associations representing automotive stakeholders to support the plan's execution. These associations have been applauded for ensuring the industry is transparent and unifying the industry as a whole. These associations include the National Association of Automobile Manufacturers of South Africa (Naamsa), representing the new vehicle industry, National Association of Automotive Component and Allied Manufacturers (Naacam) representing the component manufacturers and the Retail Motor Industry Organisation (RMI) as representative of the automotive retail sector (Figure 2-8). The African Association of Automotive Manufacturers (AAAM) are an independent association, which are also affiliated with OEMs and Naacam and aims to develop the pan-African automotive industry. The Motor Industry Ombudsman of South Africa (MIOSA) are available to the industry for dispute resolution. (Lamprecht, 2020)

Figure 2-8 The organisational structure of the South African automotive industry

Another association, which is a collaboration between the DTIC, Naamsa, Naacam and the National Union of Metalworkers of South Africa (Numsa) and OEMs, is the Automotive Supply Chain Competitiveness Initiative (ASCCI). The ASCCI aims to improve the competitiveness of the automotive value chain by upgrading supplier competitiveness, increasing local content levels and improved insights into policymaking and regulatory issues that could support the industry's growth (B&M Analysts, 2017). The industry is supported nationally to align industry initiatives and regionally across the nine provinces to address needs specific to different geographic areas. This includes developing the Special Economic Zones (SEZ) in 2007, which consists of four categories: Industrial Development Zones (IDZs), Free Ports, Free Trade Zones and Sector Development Zones (the dtic, no date b).

The global automotive industry and how South Africa fits into the global automotive industry have been discussed. The South African automotive industry's history, the development of industrial policies in the industry, and the organisational structure have also been discussed. The global automotive value chain structure and the global value chain analysis of the automotive industry will be discussed in the next section.

2.3. Global Value Chains: automotive industry

A value chain is a comprehensive description of all the activities necessary to describe a product from conception to the end of its life cycle. The activities described includes design, production, marketing, supply chain management and customer support. Regarding global value chains, these activities are usually distributed globally between various firms. (Gereffi and Fernandez-stark, 2011)

As with other global industries, the automotive industry has seen considerable growth in Foreign Direct Investment (FDI), global production, and international trade since the 1980s. In 1975 seven countries contributed to almost 80% of world production, whereas 11 countries contributed the same percentage in 2005. Also, these global industries are identified by increased outsourcing, and value-adding activities are concentrated at supplier firms that have become global suppliers. (Sturgeon and Van Biesebroeck, 2009)

Sturgeon and Van Biesebroeck (2009) regard the automotive industry's economic geography as complex and argues that the automotive industry is neither fully global nor constrained to a specific nation or location.

The integration of buyer-supplier relationships has seen the most global integration in the automotive industry. Production of bulky, heavy, and model-specific parts are based regionally or nationally, whereas lighter and generic parts are produced at larger proximities to take advantage of economies of scale and low labour costs. The design process of vehicles are based at OEM head offices; therefore, "local, national and regional value chains in the automotive industry are 'nested' in the global organisational structures" (Sturgeon and Biesebroeck, 2011).

In order to understand how global automotive value chains are organised and to support the development of new programs and policy decision making, various literature has applied the GVC analysis approach to the automotive industry. GVC analysis's application enables a holistic view of all the global firms conducting the value chain activities from a bottom-up and top-down perspective (Gereffi and Fernandez-stark, 2011). The GVC approach also defines the macro, inter-frim and micro-units of analysis and how these interact with each other to bring a product from conception to market (Frederick, 2014).

Application of GVC analysis in the automotive industry

Kaplinsky (2000) applies GVC analysis to the global automotive component sector to understand the unequal spread of gains in the global automotive value chain.

- It was found that domestic component manufacturers in developing economies struggle due to global sourcing of components and OEM follower supply policies. Therefore, component manufacturers in developing countries need to be connected to final buyers or top tier suppliers and be globally competitive regarding quality and cost to take part in value chains.
- The most substantial rents lie in the core design activities, which are usually owned by OEMs and first-tier MNCs, where developing countries only design peripheral activities.
- The critical policy implications deduced from the analysis indicated that global production networks are ever more complex, and developing countries should take advantage of high-income activities when taking part in GVCs. The critical question is how to enter global value chains and how emerging economies can sustain their position in GVCs.
- OEMs and multinational suppliers are the major global actors, and policies should be focused on influencing these stakeholders. The question is, thus, how to influence these stakeholders to ensure a viable business case.
- Kaplinsky (2000) suggests directions in which firms and countries can move to take advantage of higher rents in the automotive GVC; these are improving internal operations, improving supply chain linkages, introducing new or improved products faster than rivals or changing the mix of activities and focusing on higher-income activities. Again the question lies in which activities should be improved or how to change the mix of activities.
- Suggestions for the government from the study include assisting the private sector by doing a SWOT analysis for participating in GVCs and how to participate in GVCs, repositioning the corporate sector and ensuring quality complementary services such as physical infrastructure, financial intermediation, human resources and trade policies.

Sturgeon *et al.*(2009) apply GVC analysis to the automotive industry to distinguish the industry from other industries (for example, electronics, apparel and consumer goods), to define the role of regional and global suppliers and explain the reason for the geographical production of the industry. The study found that:

- The industry is defined by high competition between a handful of powerful lead firms. These firms rely on custom parts and subsystems specific to models and OEMs for competitive advantage. However, the lack of standardisation causes the inability to reach economies of scale in production and economies of scope in design functions, which leads to high cost.
- Due to technical expertise, political sensitiveness, and different market requirements, the final assembly and production of certain parts are close to end markets. Also, the industry is associated with high employment and high unionisation rates. Thus, with the powerful lead firms and associated industries, the automotive industry enjoys considerable attention from policymakers. The political structures have a significant influence on the patterns of FDI in the automotive industry.
- The considerable buying power of large established automotive lead firms enables them to steer the automotive industry's economic geography.

These are two applications of GVC analysis on the automotive industry to illustrate the most widely used framework for analysing GVCs (Gereffi and Fernandez-stark, 2011). Sturgeon and Gereffi (2009) regard the GVC framework as a "useful guide" to understand the linkages in the value chain, how power is distributed across actors in the value chain, and the role institutions have in the business relationships and the geographical layout. However, Sturgeon and Gereffi (2009) are concerned with using only qualitative information for designing policy interventions and states that quantitive measures are needed to support the findings in GVC analysis. Frederick (2014) also comments that many studies only focus on parts of the GVC analysis, translating to incomplete information. Most GVC studies are also not based on trade coding systems; thus, it is cumbersome to improve, update or expand GVC studies for a specific industry. Lastly, applying the GVC process is a time-consuming process (Frederick, 2014).

With a thorough understanding of the automotive global value chain and the most widely used framework to analyse GVCs, the approaches used in this study will be discussed in the following sections (Section 2.4 and Section 2.5).

2.4. Input-output Product Space framework

As developed by Bam and De Bruyne (2019), the novel IO-PS framework suggests using an input-output value chain in conjunction with the product space. This enables the evaluation of linkages between different activities in a value chain but also considers the effect of the whole product space and is not confined to a specific value chain. The product space framework and the input-output value chain is discussed in this section by addressing the product space (Section 2.4.1) and input-output value chain analysis (Section 2.4.2).

2.4.1. The Product Space

Due to market failures associated with structural change, which includes coordination and market failures (Hausmann et al., 2006), industries tend to not move to activities that promise medium to long term economic benefits to the economy as a whole (The dti, 2018). Thus, industries tend to move to activities with the same capabilities already acquired through current activities instead of moving to activities that would ensure structural growth (Hausmann and Klinger, 2008). According to C.A. Hildago et al. (2007), "economies grow by upgrading the type of products they produce and export." It has been shown that countries experience economic growth when they focus on new products which require some of the capabilities already owned by other products. Thus, the new products are related to products already produced. In order to study the relatedness of products, C.A. Hildago et al. (2007) developed the product space.

The product space can be described as a forest, where the trees represent products produced by a country and monkeys, living on the trees and using the fruit of the trees, represent the companies in a country. Growth is defined as moving from poorer trees where there is less fruit to richer trees with more fruit. Thus, monkeys have to jump distances to move to different trees, which translates to companies changing capabilities to be able to produce new products. C.A. Hildago et al. (2007) shows that the structure of the forest is heterogeneous and has a core-periphery structure, where trees are closer in the dense core and further apart in the periphery, which implies that monkeys have to jump different distances to reach new trees. If monkeys are not able to jump the distances, they will be unable to move to richer parts of the forest. This implies that not all countries have the same development opportunities, and C.A. Hildago et al. (2007) shows how richer countries are at the core where more development opportunities are available. In contrast, poorer countries are in the periphery where fewer opportunities are available for development (Figure 2-9). Therefore, it is evident that different countries have different product space structures and countries are in different positions in the product space. Which also relates to policymaking towards structural growth. The policies developed to jump shorter distances will be different from those developed to jump longer distances which promise more structural growth.

The product space relies on proximity and revealed comparative advantage to empirically determine which products are closer to move to in terms of their capabilities, which will be discussed in the next section.

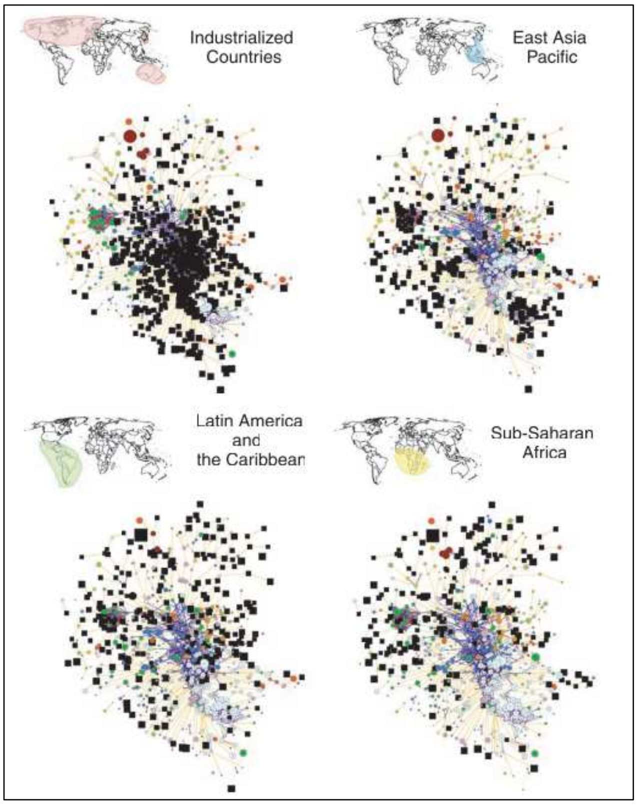


Figure 2-9 Rich countries export products at the core of the product space and poor countries export products in the periphery (Black blocks are products for which countries have an RCA) (César A. Hidalgo *et al.*, 2007)

Proximity and RCA

As mentioned in the previous section, the product space can be defined as a network of relatedness between products. The relatedness between products depends on the inputs (e.g. labour, land, capital, technological sophistication and institutions) needed to produce products. If two products are related in terms of their inputs, it is assumed that these products are likely to be produced together, whereas products that do not have the same inputs would not necessarily be produced together. The measure of proximity quantifies this idea, which can also be explained by exporting apples and pears; if a country already exports apples, it will most likely have the capabilities to be able to export pears. These capabilities will include logistics, farming expertise, climate conditions and land and the necessary local farming laws and trade laws will already be in place. When considering copper wires or home appliances, the same capabilities owned by the apple farming industry cannot readily be redeployed to manufacture them. (César A. Hidalgo et al., 2007)

Firstly, to define proximity, there is a need to define the revealed comparative advantage (RCA). The method used by C. A. Hidalgo *et al.* (2007) is based on the definition of Balassa (1986), which defines RCA for a country as the ratio of a product's exports as part of a country's total exports divided by the ratio of the product's global export to total world exports of the product (Hidalgo and Hausmann, 2009). The formula for this definition (C. A. Hidalgo *et al.*, 2007):

$$RCA_{c,p} = \frac{x(c,p)}{\sum_i x(c,p)} \Bigg/ \frac{\sum_c x(c,p)}{\sum_{c,i} x(c,p)} \qquad \text{Equation 2-1}$$

In Equation 2-1, $x(c,p)$ denotes the exports of country c of product p. Using the equation of $RCA_{c,p}$ it is possible to define a matrix which links countries with products, M_{cp} (Hausmann *et al.*, 2011), where:

$$M_{cp} = \begin{cases} 1 & if\ RCAc, i\ \geq 1 \\ 0 & otherwise \end{cases} \qquad \text{Equation 2-2}$$

Proximity can then be mathematically denoted by the conditional probability that if product p is exported by a country, then product p' will also be exported (Hausmann *et al.*, 2011). Thus, for two products p and p', proximity can be defined as (C. A. Hidalgo *et al.*, 2007):

$$\emptyset_{pp'} = min\,\{P\,(M_{\,cp}|M_{cp'}), P(M_{cp'}|M_{\,cp})\} \qquad \text{Equation 2-3}$$

The higher the minimum pairwise probability that a country has RCA in both products gives an indication of goods needing the same capabilities, thus the higher the proximity between products and the assumption that the more capabilities these products share (Hausmann and Klinger, 2008). Proximity measures the relatedness between products, and to quantify how far a country is from products it does not yet produce, the distance measure is used. Distance is the sum of proximities of all products not yet exported by a country that is connected to the new product. (Hausmann *et al.*, 2011) Distance is defined as (Hausmann *et al.*, 2011):

$$d_{cp} = \frac{\sum_{p'}(1 - M_{cp'})\emptyset_{pp'}}{\sum_{p'} \emptyset_{pp'}} \qquad \text{Equation 2-4}$$

Economic Complexity Index and Product Complexity Index

Another measure in the product space literature is a country's economic complexity, which is based on the products a country exports; a country's export basket is an expression of the capabilities owned and how these capabilities are applied to develop these products (Hausmann *et al.*, 2011). These capabilities include, among others, specialised technology, labour skills, property, access to raw materials and infrastructure (Hausmann and Klinger, 2008). Economic complexity is compared to Lego buckets; if two children each have a bucket with Lego blocks, the models (products) they build from their buckets indicate the blocks (capabilities) they have in their respective buckets. However, it is also a representation of the ability to put the blocks together to create a model. Therefore, the diversity of products a country exports represents the capabilities (Lego blocks) owned by the country (Lego bucket) and how these capabilities are used to develop new products (Lego model). A country's performance lies in its ability to accumulate capabilities and find new ways to apply all its capabilities. (Hidalgo and Hausmann, 2009)

In order to calculate complexity, diversity and ubiquity need to be defined. Firstly, the diversity of products of a country is related to the capabilities owned by that country. Secondly, products that need a large variety of capabilities will be exported from fewer countries and ubiquity is defined as the number of countries that produce a product (Hausmann *et al.*, 2011). The functions for diversity and ubiquity are defined, respectively (Hausmann *et al.*, 2011):

$$Diversity = k_{c,0} = \sum_{p} M_{cp} \quad \text{Equation 2-5}$$

$$Ubiquity = k_{p,0} = \sum_{c} M_{cp} \quad \text{Equation 2-6}$$

The Method of Reflections refers to the process of connecting two mutually exclusive sets in a bipartite network, where countries are one set, and the products exported by these countries are the second set. The process is explained by Hildago and Hausmann (2009) as "iteratively calculating the average value of the previous-level properties of a node's neighbours" and can be defined as follows (for $N \geq 1$):

$$k_{c,N} = \frac{1}{k_{c,0}} \sum_{p} M_{cp} \cdot k_{p,N-1} \quad \text{Equation 2-7}$$

$$k_{p,N} = \frac{1}{k_{p,0}} \sum_{c} M_{cp} \cdot k_{c,N-1} \quad \text{Equation 2-8}$$

After iteratively calculating the previous-level properties using above mentioned formulas, the process converges and depict the values of complexity, which is normalised by dividing by the number of countries and number of products respectively and is referred to as the Economic Complexity Index (ECI) for countries and Product Complexity Index (PCI) for products (Hausmann *et al.*, 2011).

Economic complexity describes the productive capabilities owned by countries, but Hausmann *et al.* (2011) also show a correlation between economic complexity and income per capita; it can therefore explain why there are differences in the income levels of different countries. If a country's economic complexity is high when considering their income levels, they tend to grow faster than for countries whose income levels are relatively high for their current economic complexity level. Thus, economic complexity also explains why different countries experience different levels of income and could be used to predict future growth. (Hausmann *et al.*, 2011)

Moving through the Product Space

The product space structure implies a country's specialisation pattern, and movements to new products are usually to products closely connected in terms of proximity (César A. Hidalgo et al., 2007). Developing countries tend to have activities in the "periphery" where activities share few capabilities, thus are further apart in terms of proximity and therefore moving to higher value-adding activities is more complicated. Compared to developed countries, which tend to have activities in the "core" of the product space (C. A. Hidalgo *et al.*, 2007), because in the "core", there are more shared capabilities between activities (Hausmann and Klinger, 2008).

In order to reach the core of sophisticated products, countries need to move through the product space by jumping distances. As developing countries usually have activities in the "periphery", they need to move more considerable distances in order to acquire new activities (C. A. Hidalgo et al., 2007). The South African product space can be seen in Figure 2-10, where the coloured nodes represent the products being exported with an RCA (grey dots indicating products in the product space for which the country does not have an RCA) and the size of the node representing the proportion of the product's export value of total exports. The relatedness of products to other products are depicted by the lines connecting the nodes (with all high proximities indicated through lines, while low proximities between products are omitted). For the case of South Africa, it can be seen that the nodes for cars, ferroalloys, diamonds, gold, iron ore and coal briquettes are considerably more prominent than the other nodes. These nodes represent a high proportion of the country's exports, where for example, gold, ferroalloys and cars represent 15,5%, 3,45% and 5,9% of total exports, respectively, for 2018 (OEC, 2020).

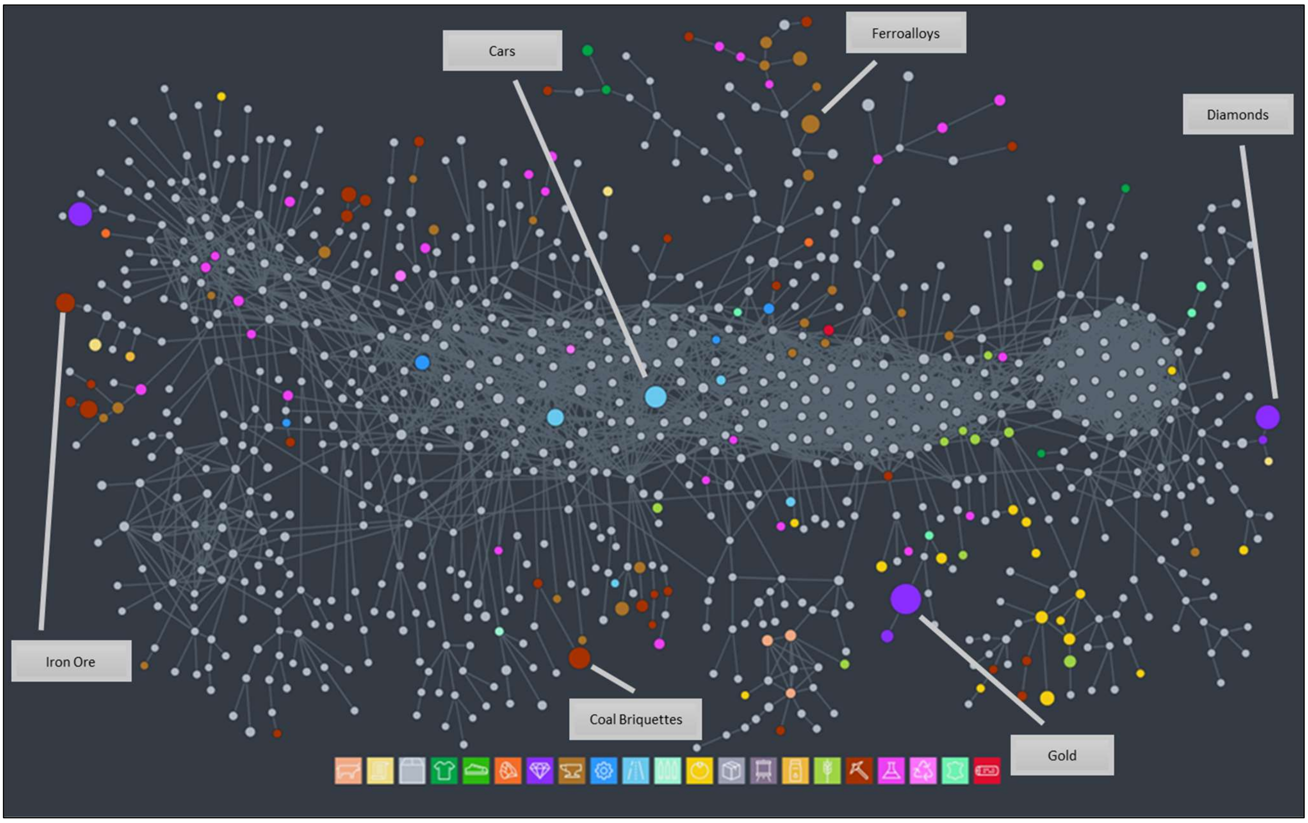


Figure 2-10 A representation of the South African product space (OEC, 2020)

Thus, different countries have different product space structures, which translates to different paths of structural growth. Also, the type of products close to a country's current production structure indicates different growth opportunities. Hausmann and Klinger (2006) developed the "open forest" measure to measure the potential available in a country's current production structure. Which was later refined to opportunity value and opportunity gain. (Hausmann and Klinger, 2006)

Opportunity value and opportunity gain

As mentioned earlier, the product space represents the relatedness of products exported by a country and where a country is positioned in the product space. The opportunity value of a country enables evaluating a country's position in the product space by calculating how far a country is from new products and determining how complex these products are. Thus, the higher the opportunity value, the closer the country is to more products and/or more complex products, which translates to increased structural growth (Hausmann *et al.*, 2011). The equation of opportunity value is depicted in Equation 2-4 (Hausmann *et al.*, 2011):

$$opportunity\ value\ _c = \sum_{p'} (1 - d_{cp'})(1 - M_{cp'})\ PCI_{p'} \qquad \text{Equation 2-9}$$

When comparing opportunity value with the ECI and income, it is evident that countries with low complexity levels tend to have few opportunities available as these countries usually lie in the periphery of the product space. In contrast, countries with high complexity values have few opportunities to develop as they already produce most of the products in the core of the product space. Finally, countries with average complexity values differ in the opportunities available (Hausmann *et al.*, 2011). Opportunity value can be used to determine the potential benefit to a country when a new product is acquired. This idea is defined as opportunity gain and is formulated as (Hausmann *et al.*, 2011):

$$opportunity\ gain_{\ c} = \sum_{p'} (\frac{\emptyset_{pp'}}{\sum_p \emptyset_{pp'}} (1 - M_{cp'}) PCI_{p'} - (1 - d_{cp} PCI_p) \qquad \textit{Equation 2-10}$$

In this section, the logic behind the PS framework was discussed, and it was explained how the product space could highlight activities for possible economic growth. The equations used to calculate complexity, proximity, opportunity gain and opportunity value which will be used to calculate these measures for the automotive value, were discussed. The concept of the input-output value chain analysis is discussed in the following section.

2.4.2. Input-output value chain analysis

For the application of the IO-PS framework and as the name suggests (“input-output”), Bam and De Bruyne (2019) use the concept of using nodes to represent how inputs (such as raw materials or parts) are transformed to outputs (for example, intermediate goods or final goods). Thus, these nodes are connected by “input-output” relationships. To map the IO value chain, Bam and De Bruyne (2019) suggest using the input-output and make and use tables from the US Bureau of Economic Analysis (BEA). They further recommend using the Harmonised System (HS) Concord tables to convert value chain activities to HS trade codes. The value chain can then be further refined by using information from Broad Economic Categories as developed by the Department of Economic and Social Affairs from the United Nations (UN). These tables will now be discussed.

Input-output and make and use tables

The input-output tables represent the relationships between industries by showing how goods and services, which are used during the production process, flow between industries. Different frameworks are used to present the input-output information, but the make-use approach will be used for this study. The make-use tables represent the production of each commodity by industries and also the consumption of input commodities for use in production. The HS Concord tables are used to translate the IO codes to HS trade codes. (bea, 2020)

Harmonized Commodity Description and Coding System

The “Harmonized Commodity Description and Coding System” or “Harmonised System” is a system to classify products and was created by the World Customs Organization (WCO) in order to have a “universal economic language and code for goods” for international trade. The system consists of more than 5000 commodity groups, which covers 98% of internationally traded commodities and are identified by a six-digit code. (World Customs Organisation, no date) This system, implemented in 1988, was reviewed and changed in 1996, 2002, 2007, 2012 and 2017; these revisions are classified according to H1, H2, H3, H4 and H5, respectively.

The system follows a structure of 21 sections with 96 Chapters which comprise 1200 headings. The first two digits of the six-digit code indicate the chapter; the following two digits indicate the heading's location in the chapter, and the last two digits divide the headings into sub-headings. Thus, HS code 870110 indicates that the commodity is in the first heading of the eighty-seventh chapter in the first subheading, which has not been subdivided. The WCO tables define chapter 87 as “Vehicles other than railway or tramway rolling stock, and parts and accessories thereof", heading 01 is defined as "Tractors; other than tractors of heading no 8709", and the first subheading, 10, is defined as "Tractors; pedestrian controlled" (Figure 2-11). (World Customs Organization, n.d.)

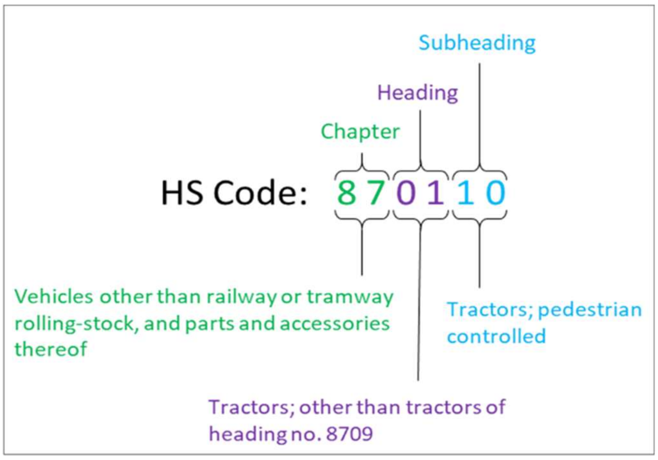


Figure 2-11 Breakdown of HS code structure

The classification depends on legal and logical guidelines and is defined by specific rules maintained by the WCO, which ensures uniformity and makes updates regarding developments in trade and technology. The most recent version of the HS was launched in January 2017. The HS system is used by different stakeholders for, amongst other things, to manage customs compliance and for economic research and analysis. (World Customs Organization, n.d.)

Standard International Trade Classification (SITC)

The HS and SITC are the main international trading coding system currently in use. The SITC is published by the UN and works on the same principle as the HS. The SITC codes are defined to the 5-digit level to determine broad categories of commodities, but the UN Trade Statistics department deem the system not as detailed as the HS, and therefore the HS will be used for this project. (UN Trade Statistics, 2010)

Broad Economic Categories (BEC)

The BEC aims to classify products into high-level economic categories related to specific industries for global trade analysis and can be translated to Standard International Trade Classification (SITC), HS trade codes and Central Product Classification (for services). The BEC categories are based on the classification of economic activities by the International Standard Industrial Classification of All Economic Activities (ISIC). According to the ISIC, economic activities are defined by the type of production carried out by economic units, which can be arranged to form industries. When the BEC was created, it could only be linked to SITC, but the 2002 edition of the BEC included links to the HS, which is preferred for goods as it is a more comprehensive system. (United Nations Statistics Division, 2002)

In this section, the information used to develop the input-output value chain used for the application of the product space was discussed. In the next section, the background of the location framework, LDEF, will be explained.

2.5. Location Determinant Evaluation Framework (LDEF)

The second framework which will be used to understand the location success factors of the output from the IO-PS is the LDEF. This framework enables the analysis of location success factors by systematically working through the phases of the framework, as suggested by Bam, De Bruyne and Schutte (2020). This chapter consists of an overview of the LDEF (Section 2.5.1.) and the different phases of the framework, which include setting the unit of analysis (Section 2.5.2.), market analysis (Section 2.5.3.), location analysis (Section 2.5.4) and finally interaction and dynamic analysis (Section 2.5.5.).

2.5.1. Overview of the LDEF

Efficient supply chain management is vital for competitiveness. In order to be successful in supply chain decision-making, it is of essence that decision-makers of MNCs can compare different locations in terms of key performance indicators for the success of the firm. These measures include, among other things, lead time, inventory and responsiveness. It is essential to not only look at cost factors, but compare different factors in terms of importance, e.g., a country can offer low wage costs, but the workforce might not have the skills to ensure the output complies with the required quality. (Bhatnagar and Sohal, 2005)

The LDEF framework aims to provide a tool for deciding on optimal locations for economic activities by systematically evaluating the success factors relating to the location of the activity and the market for the activity. When the location success factors for economic activities and its markets are understood, stakeholders can understand the specific location-related factors to determine the most optimal location for the success of a specific activity. When policymakers understand which location factors are essential for a particular economic activity to be executed at a specific location, they can influence these location factors with policies to make the location more viable for the activity. (Bam, De Bruyne and Schutte, 2020)

The location decision of activities is guided by the market accessible from a specific location and the factors influencing the ability of the location to support the execution of these activities. The trade-off between markets versus the performance attainable at the location under review can be seen in Figure 2-12. It is important to note that this framework is aimed at MNCs making global decisions and governments trying to attract MNCs and indirect foreign investment. Therefore, this framework has an international approach, and when MNCs make decisions, they consider different markets at different locations, and the location they choose for manufacturing could supply different markets at different locations. As represented in Figure 2-12, different markets could have different segments with different utility functions, which could translate to different demand curves. The market-location interaction also needs to be considered; for example, trade barriers could force MNCs to establish manufacturing in a specific country if the activity is highly protected in that country. When MNCs make decisions, they need to consider a country's ability to sustain specific capabilities; also, policymakers need to ensure that a location is viable for future business developments. Therefore, it is essential to consider the expected performance of a location and expected market changes over a period; this is depicted by t and t+s in Figure 2-12.

The LDEF framework enables decision-makers to consider a specific economic activity, the firms and industry of the activity, the markets, location factors and market-location interaction in four phases, which will be discussed now.

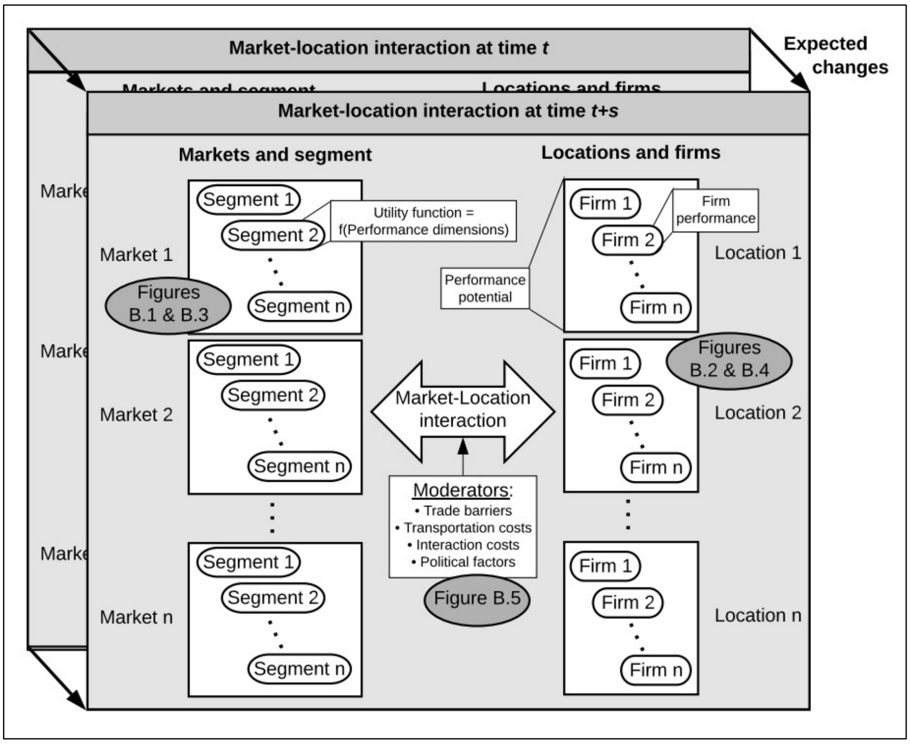


Figure 2-12 The dynamic interaction between markets and a location (Bam, De Bruyne and Schutte, 2020)

2.5.2. Phase 0: Setting the Unit of Analysis

Firstly, when starting with the LDEF, it is necessary to define the activity under review, which is the unit of analysis. The next step is to define the industry to which the activity belongs, and then the specific firms performing the activity, because different industries and the activities performed by these industries are influenced in different ways by different location factors (Bam, De Bruyne and Schutte, 2020). The industry and firm are defined according to moderating factors, which determine specific location factors vital for a specific industry or firm. For example, if economies of scale are reached at an existing location, it could be more advantageous to increase the production at the existing plant than to build a new plant at the current location or at another location where there is demand. Benefits achieved at the current location due to returns to scale might offset the cost of shipping the product to another location where there is a market. A firm-related factor is the firm's technology intensiveness, which is related to the skills needed. The more automated a firm’s processes are, the higher the need for skilled labour would be. In such instances, the level of skills and the availability of experienced, skilled labour at a focal location will be more important, whereas if a firm mainly uses manual manufacturing processes, the need for skilled labour would not be as great. The moderating factors and the possible impact on the importance of the location success factors are outlined in Table 2-3.

Table 2-3 Identification of moderating factors as suggested by Bam, De Bruyne and Schutte (2020)

	Moderating Factor	Impact on location decision making
Industry/product related	Complexity of production processes	Complexity determine the skills levels and availability needed
	Dynamism of the product market environment	The dynamism of the product market determines the capability gap, the more dynamic the product market, the more supporting services a firm may need to fill capability gaps. (Madhok, 2017)
	How easy the type of knowledge employed is spilled over	When industry knowledge is not easily spilled over, the location of supporting services, competitors or customers have a more crucial role
	Maturity of products	The more mature a firm is the greater the focus will be on improving economies of scale versus earlier stages where investments are high in terms of science development
	Economies of scale	Economies of scale enables high cost savings: if economies of scale are achieved at a location more plants might not be able to achieve the benefits from economies of scale
	Testability of the product	The testability of a product influence the support of quality management services and the trust and confidence in suppliers
Firm related	Existing global footprint	Considering performance of current locations supports future decision making in terms of new locations
	Experience in different regions	The experience at current locations can support in determining the success factors required by the firm
	Interdependence between different functions in firm	If a firm is highly interdependent on suppliers or output from other parts of the firm, other location factors are less important
	Life cycle stage of the company	Different life cycle stages relates to different firm requirements (e.g. customers of firms in development stage are more innovative versus firms in a mature stage might have permanent customers)
	Size of the firm	The size of the firm relates to the power of the firm over supplying services, for example the smaller a firm, the more important proximity will be in order to benefit from supplying services in the area
	Technology intensiveness	Technology intensiveness determine the need for skills levels and skills availability

2.5.3. Phase 1: Market analysis

After the unit of analysis is set, it is necessary to understand how location factors influence markets; therefore, the market analysis phase consists of defining the market (discussed in Market Definition 2.5.2.1), determining the market requirements (discussed in Section 2.5.2.2) and finally understanding specific location factors which influence the market for the products (discussed in Section 2.5.2.3). The information used for the market analysis was obtained from interviews and research.

2.5.3.1. Market definition

In defining the market, the LDEF suggests defining the market determinants, which include market size and segments, size of markets with similar tastes, the sophistication of customers in the market, representativeness of local customer requirements of a firm's market and market congruence with current markets (Figure 2-13). Defining the market requirement definition is discussed in the next section.

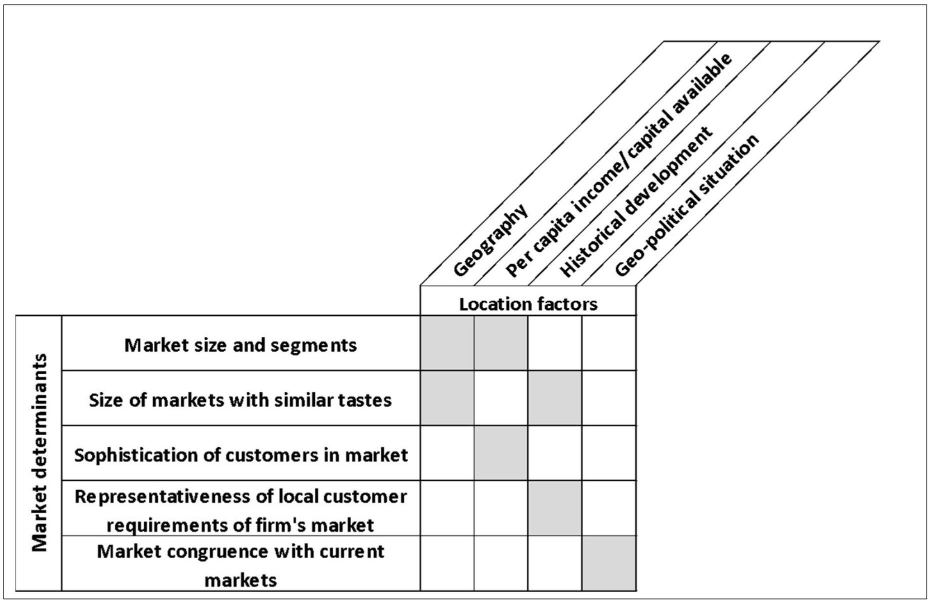


Figure 2-13 Key location factors which influence market determinants (Bam, De Bruyne and Schutte, 2020)

2.5.3.2. Market requirement definition

Bam, De Bruyne and Schutte (2020) arranged different performance dimensions according to activity type, and the dimensions considered in the manufacturing activity is cost, lead-time, flexibility, reliability, responsiveness, quality and sustainability (environmental and social impact).

2.5.3.3. Identifying location factors influencing the market

For governments to understand where changes should be made to influence a particular market and for stakeholders to understand the market accessible from a specific location, there is a need to understand the location factors which influence the size of the market and the market accessible from a specific location (Bam, De Bruyne and Schutte, 2020). The location factors considered as suggested by the location-centric framework are geography, per capita income, historical development and the geopolitical situation. The influence of the above-mentioned location factors on the market determinants can be seen in Figure 2-12, where the grey blocks represent the influence, for example, historical development has an influence on the size of markets with similar tastes and the representation of local customer requirements regarding a firm's current markets. In contrast, the geopolitical situation only influences the conformity of a market to current markets.

2.5.4. Phase 2: Location analysis

After defining the market, the performance achievable in a focal location concerning location factors is evaluated. Therefore, the location performance factors currently affecting the ability to deliver a product are considered (discussed in Section 3.2.4.1), after which these location factors are evaluated according to the moderating factors defined in phase 0 to understand the importance of the factors.

2.5.4.1. Location performance factors

The location performance factors and their relationship with the market requirements defined in Section 2.5.2.2 can be seen in Figure 2-14. It can be seen that all the location factors affect the performance of cost.

Other factors such as institutions and trust and capacity changing and switching costs affect cost, flexibility and responsiveness. In comparison, skills availability affects the performance of cost, flexibility, responsiveness and quality.

		Market requirements						
		Cost	Lead time	Flexibility	Reliability	Responsiveness	Quality	Sustainability
Location success factors	Labour costs and productivity							
	Exchange rates							
	Incentives, grants and subsidies							
	Taxes							
	Trade Protection							
	Investment barriers							
	Cost of Capital							
	Cost of industrial land							
	Availability and cost of utilities							
	Competition in factor markets							
	Managerial skills available							
	Climate							
	Transport costs							
	Corruption							
	Infrastructure							
	Nearness and quality of material inputs and suppliers							
	Nearness and quality of supporting services							
	Natural hazards based on geography							
	Institutions and trust							
	Capacity changing and switching costs							
	Contracting environment							
	Skills availability							
	Demand distance							
	Government policy and regulation							

Figure 2-14 Key-location determinants that influence activity-related performance (Bam, De Bruyne and Schutte, 2020)

2.5.4.2. Moderating factors

The firm and industry's definition emphasises particular location and market factors; therefore, the moderating factors as defined in Section 2.5.1 are used to rate the location success factors in terms of relative importance for the industry and firms performing the activity under analysis.

2.5.5. Phase 3: Interaction and dynamic analysis

According to Bam, De Bruyne and Schutte (2020), it is also necessary to compare locations on the long term performance attainable. Therefore, the effect of dynamic location factors on the market, the effect of location factors on anticipated performance and the market-location interaction need to be defined. Firstly, dynamic location factors are shown in Figure 2-15, where the greyed out blocks indicate the impact of the dynamic location factors on the market determinants. For example, the chance of migration or firm relocation and the effect on market size and segments, size of markets with similar tastes, the sophistication of customers in the market and representation of the local customer requirements of the firm's market were considered. The political dynamics of a country only affects the market segments and market congruence with current markets.

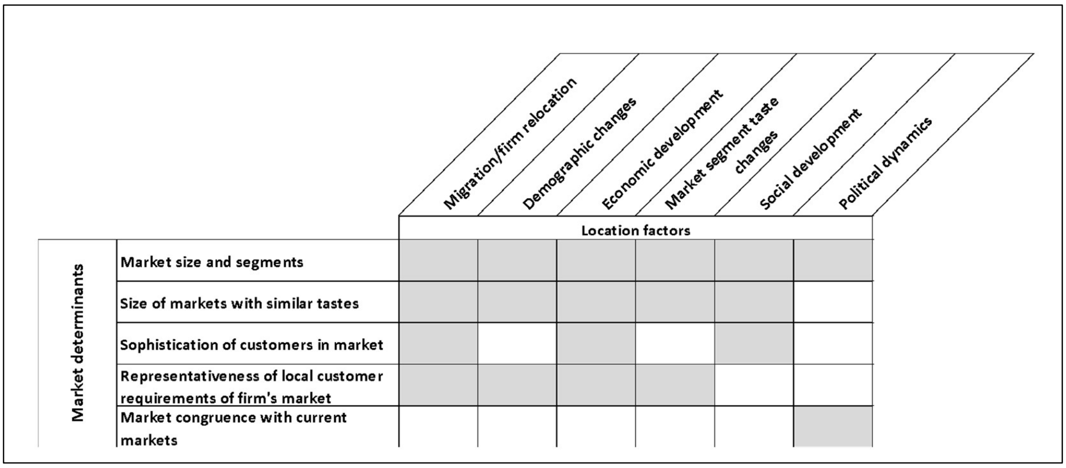


Figure 2-15 Market related dynamics (Bam, De Bruyne and Schutte, 2020)

As mentioned in Section 3.2.3.2, the manufacturing industry has specific performance dimensions required as a basis from its customers. When considering a location, it is also necessary to determine how these performance dimensions will change over time due to location factors changing at the location under study. The location dynamics and the manufacturing performance dynamics, which could be affected in the long term, can be seen in Figure 2-16. (Bam, De Bruyne and Schutte, 2020)

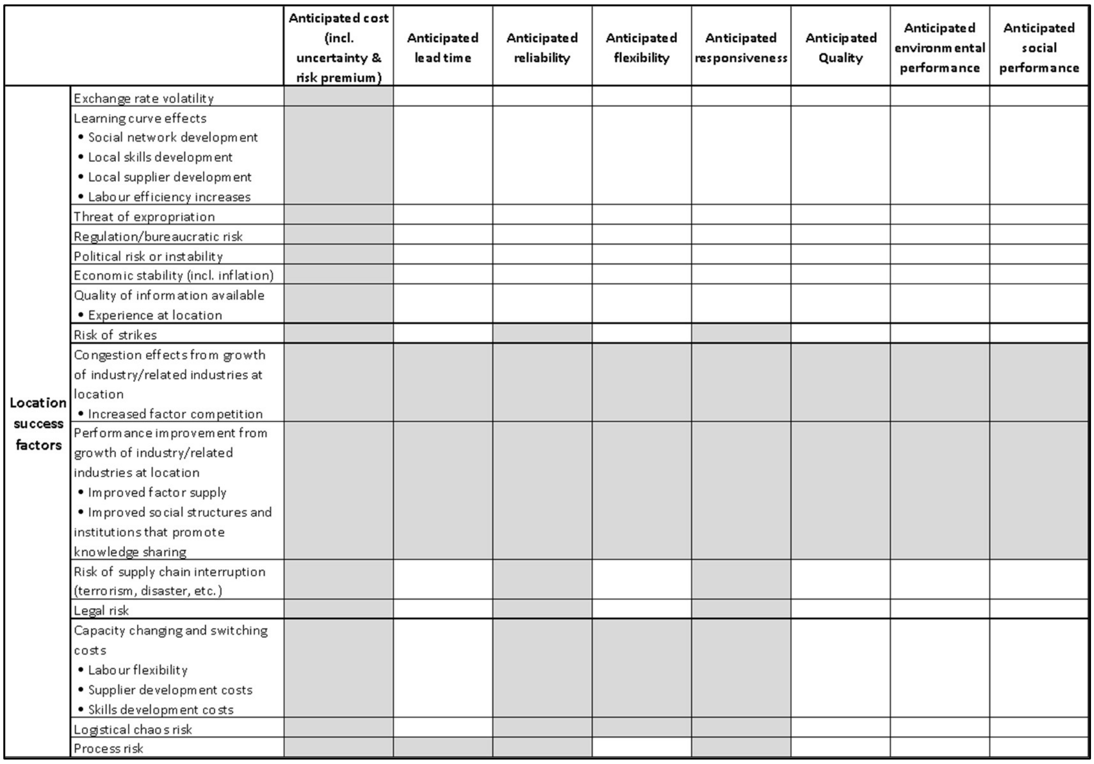


Figure 2-16 Location related dynamics (Bam, De Bruyne and Schutte, 2020)

Finally, there is a need to understand how the interaction between the market and location will change over time and the significance of the effect of these interactions; an example of these interactions is the effect of infrastructure investment on transportation costs and interaction costs, as can be seen in Figure 2-17.

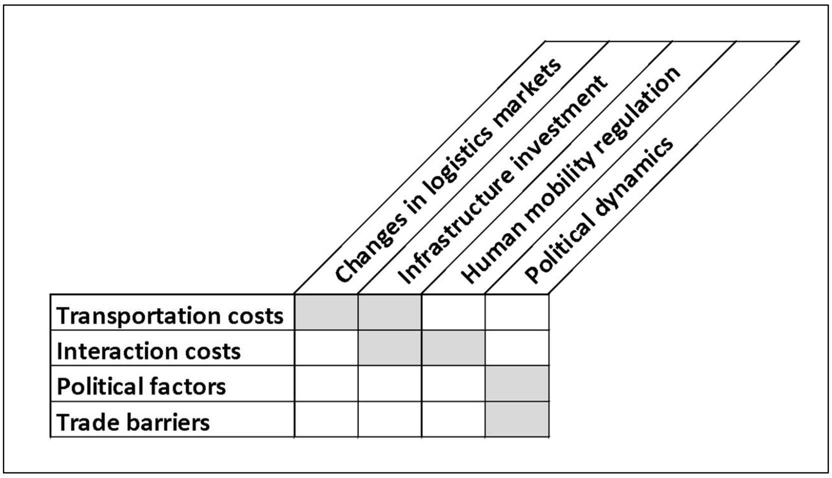


Figure 2-17 Market-location interaction (Bam, De Bruyne and Schutte, 2020)

Chapter 3

3 Methodology

This chapter describes the process of applying the IO-PS framework (Section 3.1.) and LDEF (Section 3.2.) to assess if the frameworks can be used to support policy decision making. The first step of the IO-PS framework was to build the automotive value chain (Section 3.1.1) then the product space calculations were applied to the value chain activities (Section 3.1.2), after which the most optimal activity was chosen as an input for the LDEF (Section 3.1.3). To commence with the LDEF, industry information was gathered (described in Section 3.2.1), after which the four phases of the LDEF were applied (discussed in Section 3.2.2 through 3.2.5). The framework's output then enabled the derivation of possible policy implications (discussed in Section 3.2.6). Finally, both frameworks' output was discussed to evaluate the frameworks for policy decision-making support (Section 3.3). The methodology followed in this study is represented in Figure 3-1.

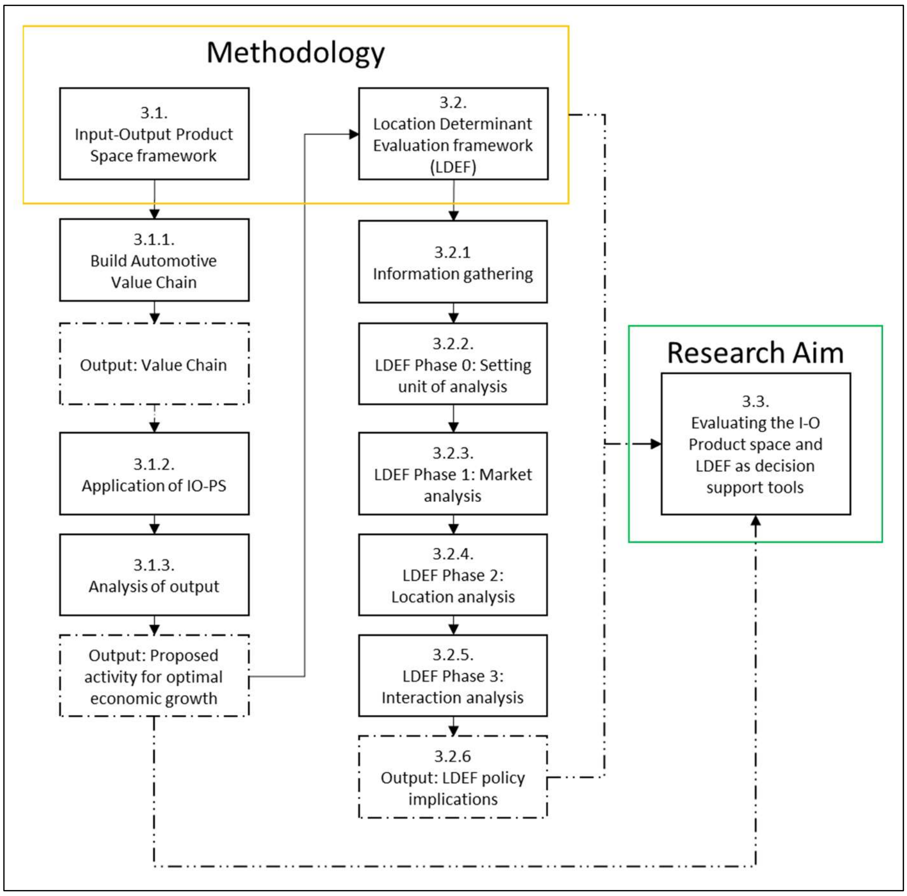


Figure 3-1 Methodology: Application of I-O product space and location determinants framework

3.1. I-O Product Space Framework

The methodology for applying the IO-PS framework can be seen in Figure 3-2. The first step in applying the IO-PS framework was to build a value chain, which was then used as input for the framework. The output from the framework was then analysed in order to determine the best opportunity for further analysis. The methods for building the value chain (Section 3.1.1), applying the I-O product space framework (Section 3.1.2) and analysing the output variables (Section3.1.3) are discussed in this section.

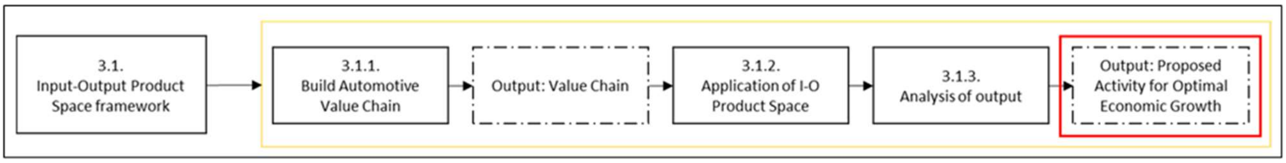


Figure 3-2 IO-PS framework methodology

3.1.1. Building the value chain

Bam and De Bruyne (2019) suggested that the first step to applying the IO-PS framework is to build an input-output value chain. The product space is based on trade data, and therefore a trade-code based value chain of the automotive industry was built. The methodology (Figure 3-3) used for gathering data for building the value chain is discussed below.

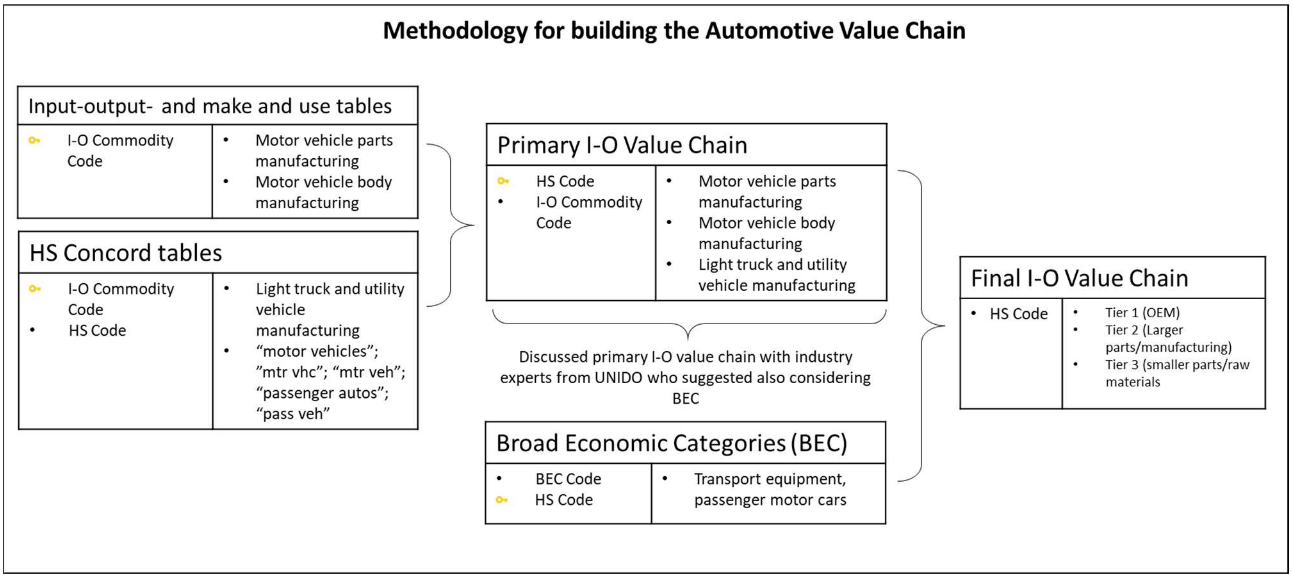


Figure 3-3 Methodology for building the automotive value chain

The first step in building the value chain was to use the US Bureau of Economic Analysis input-output tables and make and use tables from 2002. The industry was filtered for "Motor vehicle parts manufacturing" and "Motor vehicle body manufacturing" to understand which commodities are traded for motor vehicles. These commodity codes were then linked to the HS Code using the HS Concord table, which includes the input-output commodity codes, I-O commodity code description, 10-digit HS Codes and HS Code descriptions. For completeness, the HS Code descriptions of the HS Concord table were studied to find other codes which might be part of the automotive industry. If the HS description referred to "motor vehicles"," mtr vhc", "mtr veh", "passenger autos", and "pass veh", then the HS code was included. This list, together with the commodities with the code description "Light truck and utility vehicle manufacturing", was then taken as the primary input-output value chain. To ensure all the necessary commodities were included, industry experts from the United Nations Industrial Development Organization (UNIDO) were consulted, who suggested that the researcher must ensure that all categories under the Broad Economic Categories (BEC) for "passenger motor vehicles" should be included. The HS codes were then compared to the primary I-O value chain already created; the BEC HS codes were added if not included in the primary I-O value chain.

The tiers were then organised into categories according to the definition of the HS Code. The final value chain was then used as an input for the next step, which is applying the product space.

3.1.2. Application of I-O Product Space framework

With the automotive value chain built, it was possible to use this as an input for the I-O product space framework. To determine the product space variables, the MATLAB® code, as developed by Bam and De Bruyne (2019), was used with the following inputs:

1. The HS 2012 version on a 6-digit level trade data from 2017 from MIT Observatory of Economic Complexity (OEC) was used. The data is compiled by the United Nations Statistical Division (COMTRADE), but the BACI International Trade Database cleans the data by using their in-house developed harmonisation methodology, which the OEC then offers to the public on their website (https://legacy.oec.world/en/resources/data/).
2. The value chain in the form of a CSV file in the format of tier number, category number and HS Code.

It is important to note that the 2012 version (H4) of the HS was used for this study as it was the most recent revision for which cleaned trade data from the OEC was available. Thus, there was no usable trade data available for the most recent HS trade code revision launched in 2017 (HS fifth revision). Electric vehicles were only classified in the 2017 version (Descartes Datamyne, 2017). Therefore, the HS codes launched for electric vehicles could not be used in this study's automotive value chain.

The code was run for South African, Thai and Brazilian trade data for comparison purposes.

Selecting countries for Comparison:

1. Among others, Thailand and Brazil are some of the developing countries that needed government support in the form of industrial policies to get their automotive industries off the ground and still receive considerable support, the case for South Africa. These industrial policies included tariffs and local content requirements. (Black, Makundi and Mclennan, 2017)
2. Thailand and Brazil were included in the SAAM analysis, where Thailand is considered for the growth of their automotive industry and Brazil for the considerable automotive industry contraction. (Black *et al.*, 2018)

After running the I-O Product Space MATLAB® code, the output could be studied for possible opportunities in the automotive value chain.

3.1.3. Analysis of output

With the IO-PS framework's output, it was possible to analyse the South African automotive value chain's output variables. The outputs were also compared to Thailand and Brazil for a more comprehensive understanding of the South African automotive value chain relative to other competing value chains regarding the IO-PS variables.

The variables analysed were complexity, opportunity gain, distance and RCA. Complexity and opportunity gain indicate possible growth opportunities, where distance indicates how difficult it might be to reach an RCA for an activity. When considering activities for growth opportunities, categories where an RCA of 1 has been reached were excluded.

Firstly, the generic automotive value chain's average complexity values were discussed on the tier- and category level. A discussion of the average RCA, complexity and opportunity gain values on tier and category level for the South African automotive value chain followed. Thirdly, tier level values for South Africa, Thailand and Brazil were discussed. Finally, the South African data was studied on the HS code level to understand where opportunities lie on activity level to be used as input for the LDEF. As mentioned earlier, 130 HS Codes (activities) were included in the value chain and to find the most optimal opportunities for structural development; the activities were studied graphically to emphasise the activities with the highest complexity and opportunity values and corresponding distance values. According to the IO-PS values, the activities were narrowed down to eleven from which the most optimal activity was chosen for input into the LDEF.

3.2. Location Determinants Evaluation Framework

After the IO-PS analysis had identified a promising activity to focus on, the LDEF from Bam, De Bruyne and Schutte (2020) was used to determine the development of passenger vehicle body parts. The first step was to collect the information to apply to the framework; a research study was conducted to understand which location factors are essential in the global automotive industry. This information and the phases of the LDEF were used to develop a survey aimed at industry stakeholders. Feedback from interviewees and literature research on the automotive and body parts industry (explained in Section 3.2.1) was used with the framework to apply the four phases that enabled a structured analysis of the activity's location success factors. During phase 0 (Section 3.2.2), the economic activity and the firm which performs the activity was defined; phase 1 defined the market for the activity (Section 3.2.3), phase 2 (Section 3.2.4) consisted of determining the location success factors where the activity is executed or will be executed, and phase 3 (Section 3.2.5) focused on the interaction between the market and location. The phases used to apply the LDEF are represented in Figure 3-4.

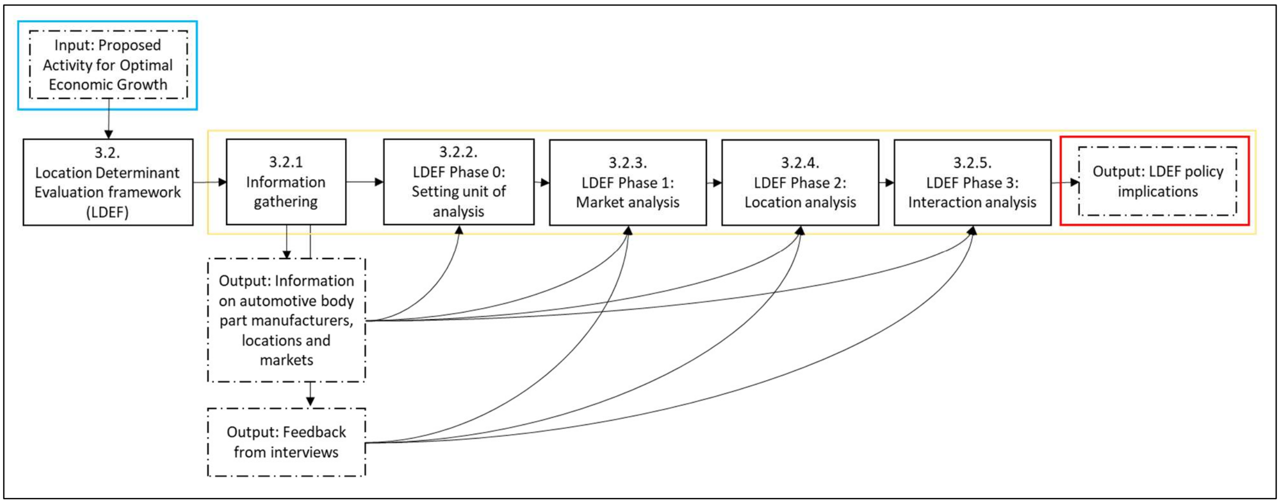


Figure 3-4 LDEF methodology

3.2.1. Information gathering

The LDEF relies on industry, activity, location and market information, and it is vital to understand how industry stakeholders perceive the chosen activity and industry. Firstly, a literature study on the automotive and body parts industry was done (discussed in Section 3.2.1.1.). Secondly, using the information collected from research and applying the LDEF, a survey was developed (discussed in Section 3.2.1.2), which was used for conducting interviews (discussed in Section 3.2.1.3). The process for gathering information can be seen in Figure 3-5.

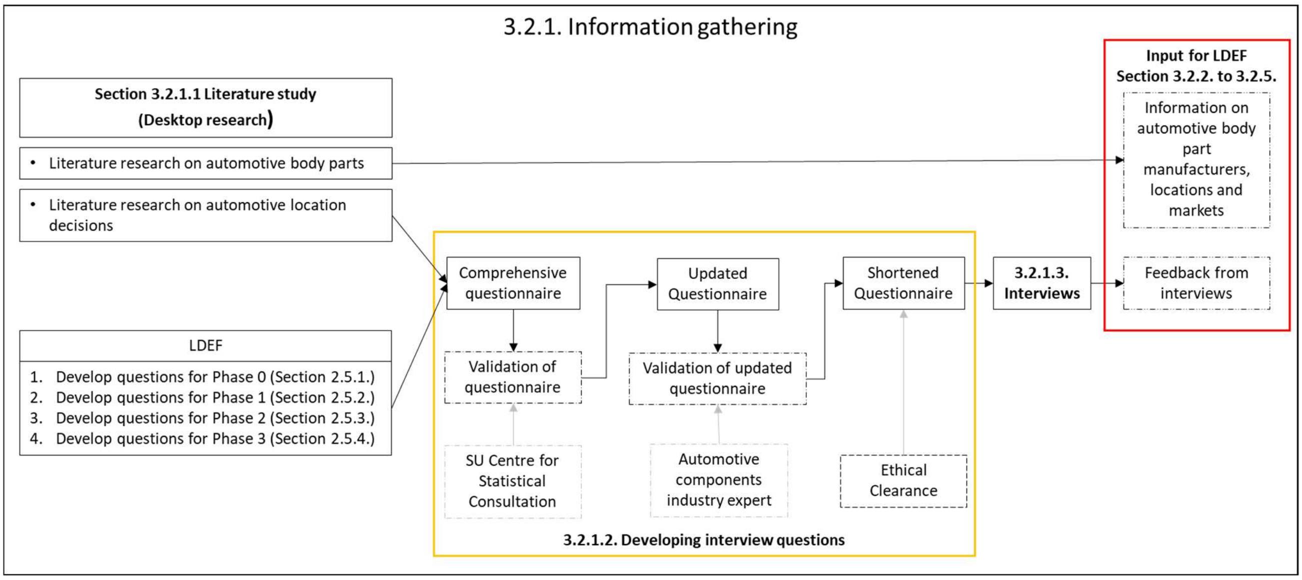


Figure 3-5 Methodology for information gathering

3.2.1.1. Literature study on automotive body parts and automotive location decisions

in order to develop a high-level picture of the global automotive industry, literature research was done to understand the location factors that are considered necessary for success in the automotive industry. Together with the LDEF phases, the research mentioned above was used to develop a comprehensive questionnaire for interviews (discussed in Section 3.2.1.2). Further research was done on the automotive body part manufacturers (identified as the focal activity in the IO-PS analysis) to understand the locations of body part firms, markets for body parts and the manufacturing of body parts, which were used to apply the different phases of the LDEF (Sections 3.2.2, 3.2.3, 3.2.4 and 3.2.5).

3.2.1.2. Developing interview questions

In order to develop the interview questions, the moderating factors, key location factors which influence the market, location factors that influence activity-related performance, market- and location dynamics and interaction dynamics from the LDEF (as discussed in Section 2.5) with literature research gathered in the previous section (Section 3.2.1.1.) were used (Figure 3-5). A comprehensive questionnaire was developed, which included each phase of the LDEF; it was then validated by a statistician from the SU Centre for Statistical Consultation (Appendix D). After that, the survey was shortened and updated to ensure more accurate feedback. The updated questionnaire was then discussed with an automotive component industry expert, who supplied supporting information and feedback, which enabled further condensing of the questionnaire, which can be seen in Appendix E. It is important to note that the LDEF is an all-inclusive guide to understand the success of a location, but due to industry experts' time constraints, interview questions were developed to understand the most critical factors and, most importantly, understand how South Africa as a location is perceived. After the questions were developed, ethical clearance was obtained, and interviewees were contacted for meetings.

3.2.1.3. Interviews

Industry experts in the automotive industry were contacted for interviews; these included experts associated with the automotive associations in the South African automotive industry and industry experts in the automotive body parts manufacturing industry. The first point of contact was an industry expert at one of the automotive associations of South Africa, who proposed industry experts in the body part manufacturing industry best suited for this study. The firms and institutions contacted for interviews can be seen in Table 3-1. The researcher could only schedule interviews with the two automotive associations and three of the body part manufacturers based in South Africa.

Table 3-1 Institutions/Firms contacted for interviews

Institution/Firm	Number of institutions/firms concacted
SA automotive association	2
Body part manufacturer	7
Aftermarket - body parts	3

Due to the privacy policy, participants and their affiliated companies will not be discussed in this document and were codified (see Table 3-2). Wherever the industry expert's comments are applied in the LDEF (Section 5.2 to 5.5), they are referred to by an alphabetic letter, as mentioned in Table 3-2. Please note, feedback from industry expert D was removed because the focus of this study is on large body part manufacturers, and industry expert D is associated with small body part manufacturing.

Table 3-2 Industry expert code with corresponding institution description

Industry Expert	Institution/Firm
A	Association of South African automotive industry
B	Association of South African automotive industry
C	Multi-national body part manufacturer with a plant in South Africa
D	Small body part manufacturer based in South Africa
E	Multi-national body part manufacturer with a plant in South Africa
F	Multi-national body part manufacturer with a plant in South Africa

Industry expert A requested that the questionnaire (Appendix E) is sent to him to fill it in on his own time. For the rest of the interviewees, 30 minute telephonic or online meetings were scheduled. The interview questions were used to guide the interview, but participants could give their opinions regarding the industry and their opinion on South Africa as a location. After the interviews, the information gathered was organised and used as input to the LDEF. Phase 0 of the LDEF will be discussed in the next section.

3.2.2. Phase 0: Setting the unit of analysis

With all the required information gathered, the first step towards determining location success factors was to define the activity for which the success factors need to be determined. The methodology for setting the unit of analysis can be seen in Figure 3-6

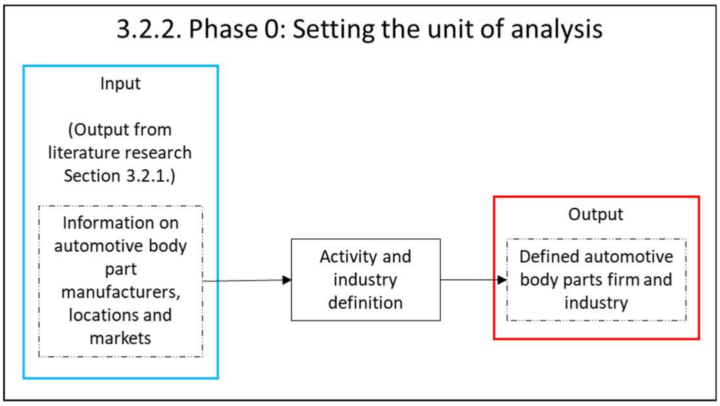


Figure 3-6 Methodology for setting the unit of analysis

Firstly, to understand the industry for automotive body parts, desktop research done in the previous section (Section 3.2.1.1) was used to define the activity by defining automotive body parts, manufacturing processes, the manufacturers of body parts, raw materials and the customers for body parts.

3.2.3. Phase 1: Market analysis

In order to understand how location factors influence markets, there is a need to understand the market for automotive body parts. Therefore, the market analysis phase consisted of defining the market (discussed in Section 3.2.3.1), determining the market requirements (discussed in Section 3.2.3.2), understanding specific location factors which influence the market for the products (discussed in Section 3.2.3.3) and finally discussing the market-related dynamics (Section 3.2.3.4). The process for defining the market can be seen in Figure 3-7.

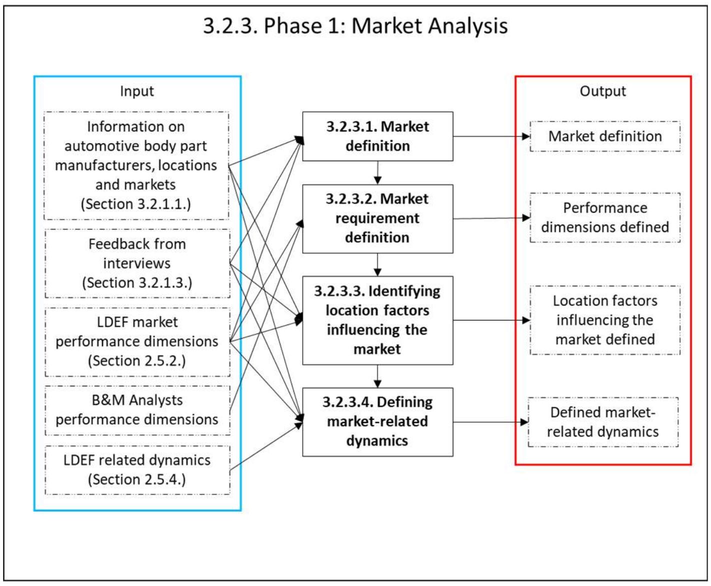


Figure 3-7 Market analysis methodology

3.2.3.1. Market definition

The market was defined by defining the market determinants (Figure 2-12), adapted for the automotive industry by removing the market congruence factor based on desktop research and feedback from the interviews conducted (Section 3.2.1.3). The sources used to define the market determinants can be seen in Figure 3-8.

		Source used to define market determinants and location factors
Market determinants	**Market size and segments**	- Interview feedback - Desktop research
	Size of markets with similar tastes	- Desktop research
	Sophistication of customers in market	- Interview feedback
	Representativeness of local customer requirements of firm's	- Interview feedback
Location factors influencing markets	**Geography**	- Desktop research
	Per capita income/capital available	- Desktop research
	Historical development	- Interview feedback
	Geo-political situation	- Desktop research

Figure 3-8 Sources used to develop market determinants and location factors influencing markets

3.2.3.2. Market requirement definition

In order to define the market requirement, the performance dimensions, as defined in Section 2.5.2.2, were used (Figure 3-9). However, they were adapted according to the results from the South African automotive supplier benchmarking report (B&M Analysts, 2020) by including product development and grouping reliability, responsiveness and lead time under one category. These performance dimensions were considered, and results regarding the importance of these dimensions to OEMs in South Africa were used to rate the importance of location factors in phase 2 (Section 3.2.4.1). After the location analysis phase, it was found that the static location determinants do not have a direct effect on the sustainability dimension for the body part manufacturing industry and was therefore removed from this section.

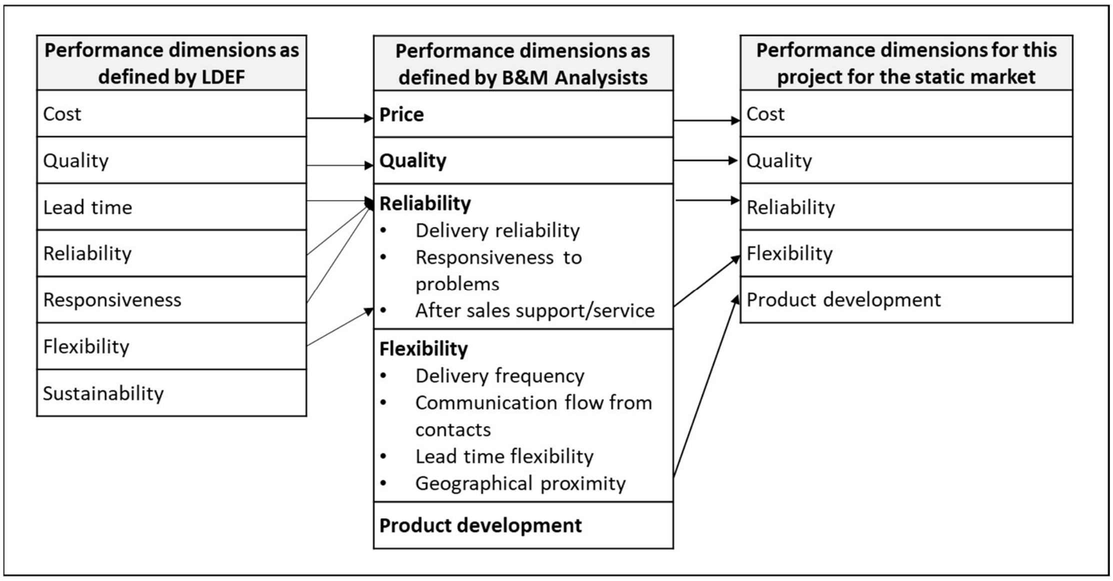


Figure 3-9 Presentation of how performance dimensions for this project were determined. (Source of performance dimensions from B&M Analysts: B&M Analysts, 2020*)*

3.2.3.3. Identifying location factors influencing the market

Location factors influencing the market for body parts in South Africa were considered using the location factors defined in Figure 2-12, desktop research, and interviewees' feedback (Figure 3-9).

3.2.3.4. Define market-related dynamics

Finally, policymakers need to understand which location factors they can influence to make South Africa a location for automotive manufacturing a more viable decision in the long term and sustain these factors. The dynamic location factors influencing market determinants used as defined by Bam, De Bruyne and Schutte (2020) and shown in Figure 2-14. The market-related dynamics were included in this phase and not in phase 3, as suggested by Bam, De Bruyne and Schutte (2020), as it eased analysis. Demographic changes and economic development were considered in conjunction because of the effect the economy has on the market's demographic determinants, such as unemployment, poverty, and education. The dynamic location factors were defined using desktop research and feedback from interviewees (Figure 3-10).

		Source used to define market determinants
Dynamic location factors influencing markets	Migration/firm relocation	- Interview feedback - Desktop research
	Demographic changes and economic development	- Desktop research
	Market segment taste changes	- Desktop research
	Social development	- Desktop research
	Political dynamics	- Interview feedback - Desktop research

Figure 3-10 Sources used to define the dynamic location factors influencing markets

3.2.4. Phase 2: Location analysis

After defining the market, the performance achievable in South Africa concerning location factors needed to be understood. Therefore, the location performance factors currently affecting the ability to deliver a product were considered (Section 3.2.4.1.). The moderating factors were also defined to understand specific location factors critical to the body parts industry/firm (discussed in Section 3.2.4.2). Finally, to comprehend the location success factors' anticipated performance, the location-related dynamics were defined (Section 3.2.4.3). The methodology of the location analysis phase can be seen in Figure 3-11.

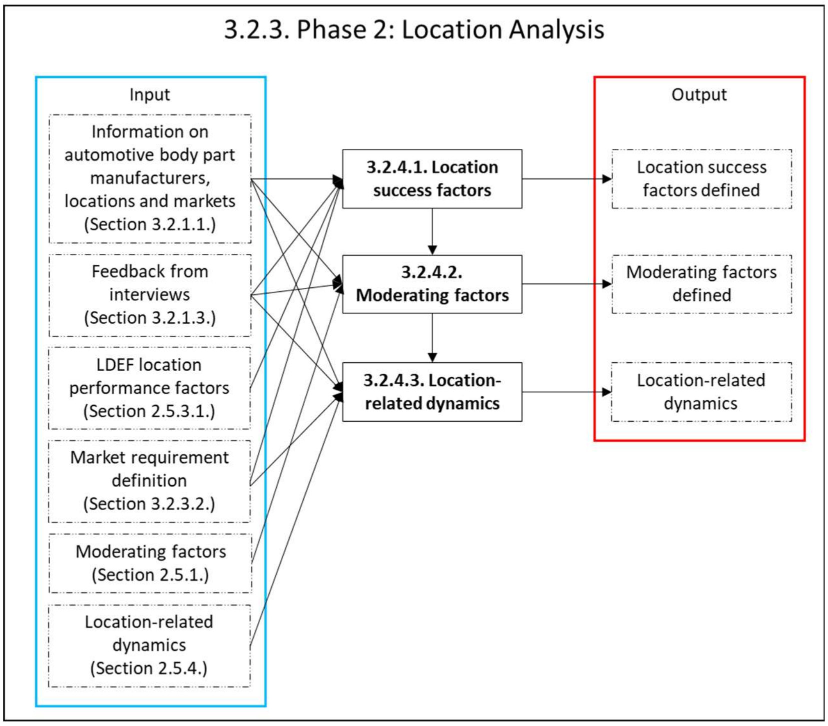


Figure 3-11 Location analysis methodology

3.2.4.1. Location success factors

The location performance factors (Section 2.5.3.1), as prescribed by Bam, De Bruyne and Schutte (2020), were adapted for the automotive industry according to the most critical location factors for the global automotive industry as considered in the literature studied in Section 3.2.1.1. The location performance factors were then defined in terms of the market requirements as defined in Section 3.2.3.2 by using feedback from interviews and desktop research. Figure 3-12 indicates the source of information used to define the location success factors.

		Information used to determine the location success factors
Location success factors	Labour costs and productivity	- Interview feedback
	Exchange rates	- Interview feedback
	Incentives, grants and subsidies	- Interview feedback
	Taxes	- Interview feedback
	Trade Protection	- Interview feedback
	Investment barriers	- Interview feedback
	Availability and cost of utilities	- Interview feedback - Desktop research
	Managerial skills available	- Interview feedback
	Transport costs	- Interview feedback
	Political instability (Corruption)	- Interview feedback
	Infrastructure	- Interview feedback
	Nearness and quality of material inputs and suppliers	- Interview feedback
	Nearness and quality of supporting services	- Interview feedback
	Institutions and trust	- Interview feedback
	Skills availability	- Interview feedback
	Demand distance	- Interview feedback
	Government policy and regulation	- Interview feedback

Figure 3-12 Adapted location success factors and source used to define the location success factors for South Africa

3.2.4.2. Moderating factors

As defined in Section 2.5.1, the moderating factors bring attention to certain location factors significant for the body part firms and industry (Figure 3-13). For this study, the moderating factors were defined in phase 2 and not in phase 0 as suggested by Bam, De Bruyne and Schutte (2020) because it highlights critical location factors defined in Section 3.2.4.1.

	Moderating factors	Source used to define moderating factors
Industry/product related	Complexity of production processes	- Interview feedback
	Dynamism of product market environment	- Interview feedback
	How easy is knowledge spillover	- Interview feedback - Desktop research
	Maturity of products	- Desktop research
	Economies of scale	- Interview feedback
	Testability of product	- Interview feedback
Firm related	Existing global footprint	- Interview feedback
	Experience in different regions	- Interview feedback
	Interdependance between different functions of the firm	- Interview feedback
	Life cycle stage of the firm	- Interview feedback
	Size of firm	- Interview feedback
	Technology intensiveness	- Interview feedback

Figure 3-13 Sources used to define moderating factors

3.2.4.3. Location-related dynamics

In order to understand the effect of changing location factors on the anticipated manufacturing performance dimensions, the dynamic location success factors defined by the LDEF (Figure 2-15) were discussed using interview feedback and desktop research (Figure 3-14). The anticipated manufacturing performance dimensions were chosen according to the location-related dynamics as defined by Bam, De Bruyne and Schutte (2020) (Section 2.5.4) and the performance dimensions as defined by B&M Analysts (B&M Analysts, 2020), as shown in Figure 3-15.

		Sources used to define dynaimc location success factors
Dynamic location success factors	Exchange rate volatility	- Interview feedback
	Learning curve effects	- Interview feedback - Desktop research
	Threat of expropriation	- Interview feedback
	Regulation/bureaucratic risk	- Interview feedback
	Political risk or instability	- Interview feedback
	Economic stability (incl. inflation)	- Interview feedback
	Quality of information available	- Interview feedback
	Risk of strikes	- Interview feedback
	Congestion effects from growth of industry/related industries at location	- Interview feedback
	Performance improvement from growth of industry/related industries at location	- Interview feedback
	Risk of supply chain interruption (terrorism, disaster, etc.)	- Interview feedback
	Legal risk	- Desktop research
	Capacity changing and switching costs	- Interview feedback
	Logistical chaos risk	- Interview feedback
	Process risk	- Interview feedback

Figure 3-14 Sources used to define dynamic location success factors

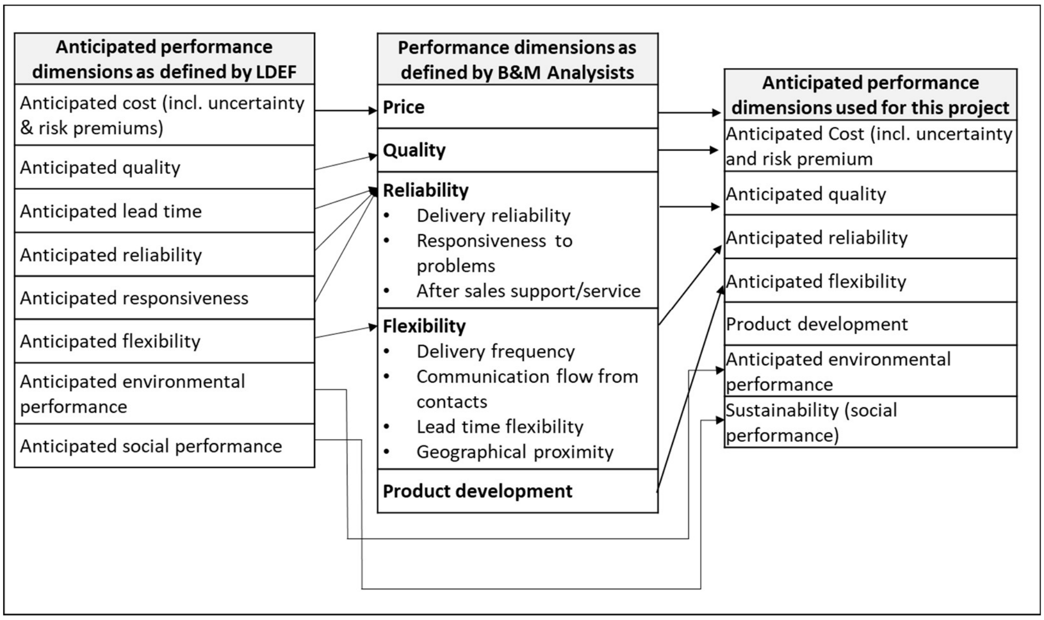


Figure 3-15 Presentation of how anticipated performance dimensions for this project were determined. (Source of performance dimensions from B&M Analysts: B&M Analysts, 2020)

3.2.5. Phase 3: Market-location interaction

Finally, it was necessary to understand how the interaction dynamics will change over time. Each of the market location dynamics was defined according to future and related effects on market dynamics using the interaction dynamics from LDEF (Figure 3-16) and interview feedback and desktop research (Figure 3-17).

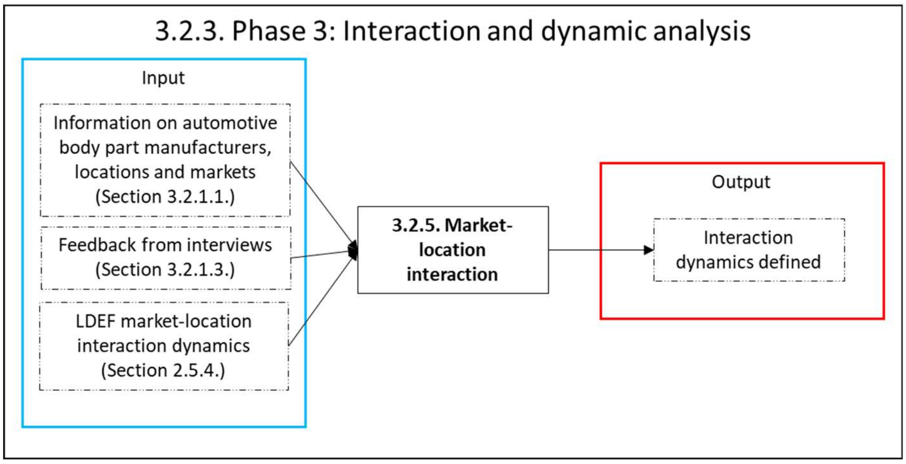


Figure 3-16 Interaction and dynamic analysis methodology

	Sources for defining interaction moderator dynamics
Transportation costs	- Interview feedback - Desktop research
Interaction costs	- Interview feedback
Political factors	- Desktop research
Trade barriers	- Interview feedback - Desktop research
Changes in logistics markets	- Interview feedback
Infrastructure investment	- Interview feedback
Human mobility regulation	- Interview feedback
Political dynamics	- Interview feedback - Desktop research

Figure 3-17 Market location interaction sources

3.2.6. Policy Implications

Finally, it was possible to consolidate all the location factors defining the market, the location success factors at a location, and the dynamic location and market factors by considering a SWOT analysis of the factors to determine the industry's policy implications.

3.3. Evaluating the frameworks for policy-making decision support

This project aims to evaluate if the IO-PS framework and LDEF can be used to support decision-makers with policymaking. Therefore, the use of the frameworks in conjunction were evaluated, but the application and output of the frameworks were also discussed separately.

The IO-PS framework was evaluated by discussing the following:

- Application of the IO-PS framework
- The use of an I-O value chain
- The use of HS trade codes analysis
- The output of the IO-PS framework

The LDEF was evaluated by discussing the following:

- Application of the LDEF using the output of the IO-PS
- Comparing the output of the LDEF with the SAAM study

The use of both frameworks was evaluated by discussing the following:

- The output of the IO-PS given the output from the LDEF
- The use of the output of IO-PS as input for the LDEF

Chapter 4

4 Input-Output Product Space analysis

This chapter presents the results of applying the input-output product space to the automotive value chain of South Africa and choosing an activity for further development. This entails a discussion of the developed generic automotive value chain for South Africa (Section 4.1), the computational results obtained from applying the framework (Section 4.2), and finally choosing an activity for the application of the LDEF (Section 4.3)

4.1. The generic automotive value chain

The final I-O value chain used for the product space consisted of 130 products and was then divided into three tiers according to the type of product:

- Tier 1: assembled vehicles (OEMs)
- Tier 2: larger parts/sub-assemblies
- Tier 3: small components, parts and raw materials

These tiers were then divided into 31 categories according to the HS code description and type of products; these categories aided in analysing the products and provided a high-level view on where development could be focused.

After discussing the value chain with an industry expert at one of the local OEMs, it was concluded that different OEMs and industry stakeholders might map the value chain differently depending on who produces which parts and who assembles the parts into components. For example, OEM A might buy parts to assemble a specific component, but OEM B might outsource the component to a Tier 1 supplier; therefore, OEM A will include the component on a higher tier as OEM B. The structure of the value chain will not compromise the IO-PS output because the variables are calculated on activity (HS Code) level. Thus, stakeholders can focus on specific activities of interest to them.

The final generic value chain is represented in Figure 4-1, where activities (products on HS 6-digit level) are sorted on category level according to the tier to which it belongs. The values under the tier blocks are the average complexity of all activities under the tier, where the values under the category blocks are the average complexity value for all the activities categorised in the category. The values in Figure 4-1 will be discussed in the next section.

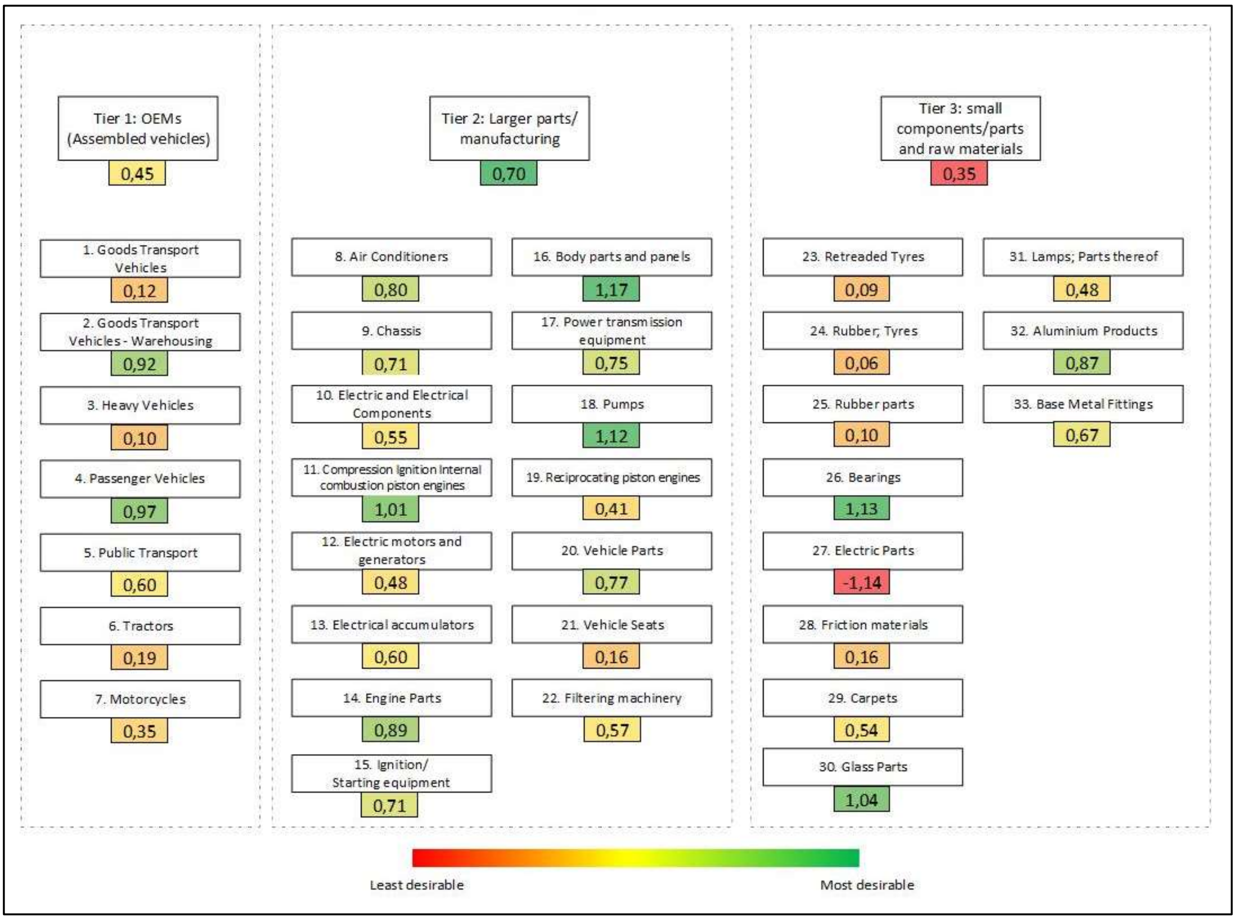


Figure 4-1 Automotive value chain with average complexity values for products on category/tier level for 2017

4.2. Analysis of the I-O Product Space Output

The I-O product space framework was applied to the automotive value chain, and this section discusses the output. Firstly, a tier level and category level analysis are presented (Section 4.2.1), and secondly, the South African data are compared to the output from Brazil and Thailand (Section 4.2.2). Thirdly, the activity level analysis of the South African automotive value chain output is presented (Section 4.2.3) to finally determine the most optimal activity for further location analysis (Section 4.2.4).

4.2.1. IO-PS variables used for analysis

This section focuses on the tier and category level analysis to provide an overall picture of the South African generic automotive value chain. The product space variables which were considered are:

1. The **RCA** represents the possibility of an opportunity to develop an activity; if the RCA is smaller than 1, it is assumed that opportunity still exists for the activity, if the RCA is greater than 1, South African possess an RCA for the activity, and it is therefore assumed that no further opportunity could be unlocked when further developing this activity.

2. **Complexity** indicates the sophistication of capabilities and how capabilities are combined in order to deliver an activity. Therefore, the lower the complexity level, the fewer capabilities are needed to produce the activity and the lower the possibility of structural growth.
3. **Opportunity gain** indicates the increase in opportunity value when a new activity is developed. The opportunity value of an activity indicates its closeness to other activities that might have high complexity. Thus, the higher the opportunity gain for an activity is, the closer this activity is to other activities, which also show an opportunity for structural growth.
4. **Distance** describes the relative position of a country relative to activities with an RCA smaller than 1; thus, the higher the distance, the more capabilities are needed to be able to produce an activity that does not yet have an RCA.

The product space variables, RCA, complexity, opportunity gain and distance, was discussed, which were used for analysis in the following sections.

4.2.2. Tier level and category level analysis

This section summarises the output from the IO-PS framework of the generic automotive value chain (Section 4.2.2.1) and the South African automotive value chain (Section 4.2.2.2) on the tier and category level.

4.2.2.1. IO-PS output: Generic automotive value chain

When considering the tier level results (Figure 4-1), it can be seen that the average complexity of products on tier level two is higher than both tier levels one and three, which indicates higher potential structural growth when developing products in this tier. The average complexity values for tier level one is more than level three, but when considering average complexity for products on the category level, there are product categories in tier level three with higher complexity values than tier level one. Naturally, there are more categories under tier level two with high average complexity values than in both tier level one and three. The category with the highest average complexity is Body parts and panels (Category 16), which fall under tier level two. Although tier level three has the lowest average complexity, the category with the second highest average complexity value (26. Bearings) falls under this tier.

4.2.2.2. IO-PS output: South African automotive value chain

The IO-PS values for the South African automotive value chain can be seen in Figure 4-2. The complexity (left-hand side) and opportunity gain (right-hand side) values are depicted under each category and highlighted from red to yellow to green to ease analysis. Higher complexity and opportunity gains are desirable, therefore the higher these values, the greener the shade. The average complexity value for each category represents products for which South Africa does not yet have an RCA in 2017.

Considering the IO-PS output for the South African value chain, it can be seen that tier one has the highest average RCA at 0,92, tier two follows with an average RCA of 0,42, and tier three has the lowest average RCA at 0,28. The ranking of the RCA values for the tiers regarding the automotive industry in South Africa echoes the statistics of the total value of vehicle exports (tier 1) at R148 billion and the value of component exports (tier 2) at R53,7 billion. Also, the high value and capital intensive components (e.g. powertrain and telematics), which constitute up to 50% of the value of vehicles, are imported (Lamprecht, 2020). The tier level complexity also highlights the complexity levels in the automotive industry value chain, where tier-one has a complexity value of 0,47 and tier one is defined as the assembly of vehicles, which is lower than the complexity level of tier 2, which consist of production of larger automotive parts and sub-assemblies.

On the category level, goods transport vehicles, heavy vehicles, passenger vehicles and filtering machinery (categories marked with a star) have an RCA greater than 1, meaning South Africa has an average revealed comparative advantage for these categories. There are three categories under tier 1 with an RCA. However, two of these, goods transport vehicles (category 1) and heavy vehicles (category 3), have very low average complexity and opportunity gain values for products which does not yet have an RCA, which implies that the opportunity for structural growth for these categories are low. The average product complexity value of 0,71 for tier 2 shows that there are short term opportunities on this level, where category 11, 16 and 18 stand out with average complexity values (for products in these categories with RCA < 1) higher than one and opportunity gain values higher than 0,3 (Lamprecht, 2020). The category with an RCA in tier two is filtering machinery, which is expected, as catalytic converters fall in this category. Catalytic converters comprised 37,9% of the value of total component exports at a value of R20,4 million in 2019 (Lamprecht, 2020). It is important to note that the complexity of this category is 0,57, which is relatively low in comparison with engine parts, for example, which comprises 8% of the value of component exports, but has a complexity of 0,89 (Lamprecht, 2020). Thus, catalytic converters are the top component being exported, but the opportunity for structural growth and to gain capabilities are low. There are no categories on tier level three with an average RCA, but there are opportunities in categories 26 and 30, with average complexities of more than one at 1,13 and 1,04 respectively for products in the category which do not yet have an RCA. Also, the average opportunity gains at 0,36 (Bearings) and 0,25 (Glass Parts) are relatively high. In the next section, a high-level comparison of the product space of the automotive value chain of South Africa, Brazil and Thailand is presented.

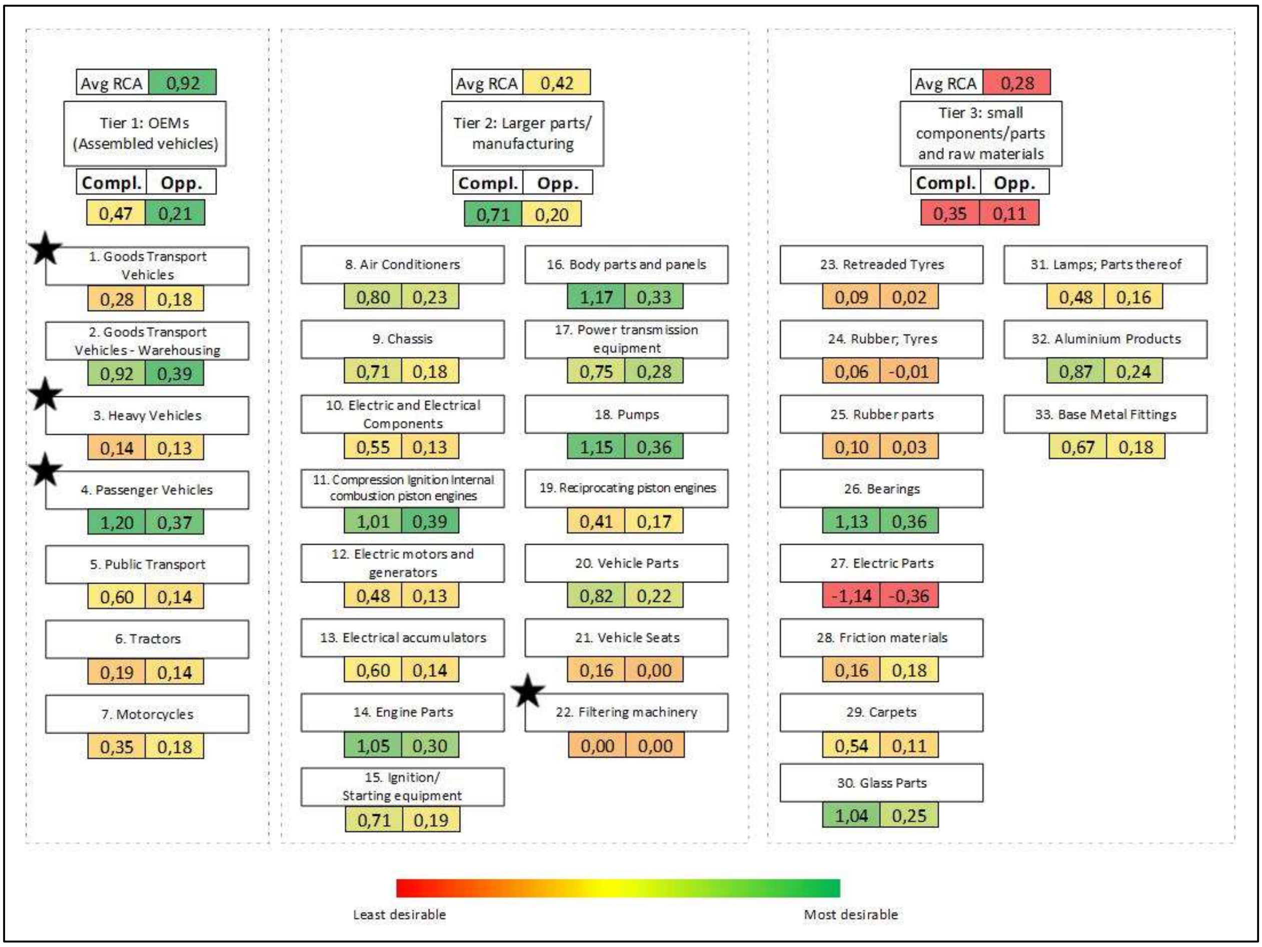


Figure 4-2 South African automotive value chain with average complexity and opportunity gain values for activities for which South Africa did not yet have RCA in 2017, where the stars (★) indicate the categories with RCA greater than one.

4.2.3. Comparison of product space variables

For a thorough understanding of the product space variables of South Africa, a comparison between the outputs for South Africa, Brazil and Thailand were made. The tier level results for average RCA, average complexity and average opportunity gain are represented in Table 4-1. Thailand has an average RCA for all three tiers, whereas South Africa and Brazil does not have RCA on any of the tiers, this confirms the considerable growth of the Thai automotive industry as mentioned in Section 3.1.2. South Africa and Brazil have relatively low RCA values for level two, where most of the activities with high complexities lie. Regarding opportunity gain, it can be seen that South Africa still has the most potential to unlock on tier 1, although it has the highest RCA value. In contrast, Thailand has an RCA for all tiers, but the most potential lies on tier level 2 because they have already unlocked more potential on tier level one than South Africa. Considering Brazil, the most potential for opportunity lies in tier 1, which compares to South Africa's situation. Brazil has the highest RCA value for tier 3, although this is the tier with the lowest average complexity for all its products (0,35) and the average complexity (0,39) and opportunity gain of products (0,09) which does not have an RCA is also the lowest of all three tiers. The difference between Brazil's tier 3 complexity for all its products (0,35) and average complexity for products without RCA (0,39) in the same tier indicates that the products for which Brazil has RCA in this tier have lower complexity values than for the ones that do not yet have RCA.

Table 4-1 Tier level I-O product space variables for developing countries

	Tier	Average RCA	Average complexity of all products in tier	Average complexity if opportunity	Average opportunity gain if opportunity
South Africa	1	0,92	0,45	0,47	0,21
	2	0,45	0,70	0,71	0,20
	3	0,28	0,35	0,35	0,11
Thailand	1	1,97	0,45	0,57	0,17
	2	1,33	0,70	0,76	0,18
	3	1,59	0,35	0,55	0,11
Brazil	1	0,73	0,45	0,52	0,20
	2	0,66	0,70	0,69	0,17
	3	0,82	0,35	0,39	0,09

In conclusion, Black *et al.* (2018) comment that for Thailand's case, government support is not necessarily focused on attracting new automotive related firms but instead focused on activities that have been identified as strategic and provides sustainable economic growth. For Brazil, their automotive industry mainly focuses on basic tier level three activities, which offer few growth opportunities. Also, Brazil is not a major exporter and is more focused on the domestic market (Black, Makundi and Mclennan, 2017), which is evident in the relatively low RCA values, especially in tier 1. In the next section, a more comprehensive study is presented of the underlying activities in the generic automotive value chain of South Africa.

4.2.4. Product level analysis

Firstly, the following table shows the activities with RCA's greater than one. From the 130 activities identified in the South African automotive value chain, sixteen have a revealed comparative advantage. These 16 activities contributed $10 billion of a total of $12,4 billion (bea, 2020) exports for the South African automotive value chain in 2017 (Table 4-2). Thus, the activities with RCA contributed 81% to the South African automotive value chain exports. The world export of these activities was 34% of world exports of the automotive value chain in 2017 (bea, 2020).

In Table 4-2, it can be seen that HS Code 842139, machinery for filtering or purifying gases, has the highest RCA, and as mentioned above, catalytic converters are included in this activity. South Africa accounted for 5,51% of the world exports of filtering machinery (Figure 4-3) in 2018 (OEC, 2020). According to SARS export data, filtering machinery was mainly exported to Europe (73%), America (14%) and Asia (12%) in 2018 (SARS, no date).

Table 4-2 Automotive activities with RCA > 1

Tier	Category	Category Description	HS Code	Activity description	RCA	Complexity	Value Chain complexity ranking
2	22	Filtering machinery	842139	Machinery; for filtering or purifying gases, other than intake air filters for internal combustion engines	10,5	0,57	70
1	3	Heavy Vehicles	871000	Tanks and other armoured fighting vehicles; motorised, whether or not fitted with weapons, and parts of such vehicles	6,5	0,91	32
1	1	Goods Transport Vehicles	870421	Vehicles; compression-ignition internal combustion piston engine (diesel or semi-diesel), for transport of goods, (of a gvw not exceeding 5 tonnes), n.e.c. in item no 8704.1	5,8	-0,08	110
1	1	Goods Transport Vehicles	870410	Vehicles; dumpers, designed for off-highway use, for transport of goods	3,1	-0,45	126
1	4	Passenger Vehicles	870332	Vehicles; compression-ignition internal combustion piston engine (diesel or semi-diesel), cylinder capacity exceeding 1500cc but not exceeding 2500cc	2,4	0,77	43
1	4	Passenger Vehicles	870333	Vehicles; compression-ignition internal combustion piston engine (diesel or semi-diesel), cylinder capacity exceeding 2500cc	2,3	0,70	56
1	3	Heavy Vehicles	870520	Vehicles; mobile drilling derricks	2,0	-0,89	128
1	4	Passenger Vehicles	870321	Vehicles; spark-ignition internal combustion reciprocating piston engine, cylinder capacity not exceeding 1000cc	1,4	0,58	67
2	20	Vehicle Parts	870990	Vehicles; parts of the vehicles of heading no. 8709	1,4	0,41	91
1	4	Passenger Vehicles	870323	Vehicles; spark-ignition internal combustion reciprocating piston engine, cylinder capacity exceeding 1500cc but not exceeding 3000cc	1,4	1,25	12
2	20	Vehicle Parts	842123	Machinery; filtering or purifying machinery, oil or petrol filters for internal combustion engines	1,2	0,52	79
2	20	Vehicle Parts	870892	Vehicle parts; silencers (mufflers) and exhaust pipes; parts thereof	1,2	0,71	52
2	22	Filtering machinery	842131	Machinery; intake air filters for internal combustion engines	1,1	0,56	74
2	18	Pumps	841391	Pumps; parts thereof	1,1	1,09	17
1	4	Passenger Vehicles	870331	Vehicles; compression-ignition internal combustion piston engine (diesel or semi-diesel), cylinder capacity not exceeding 1500cc	1,0	0,65	62
2	14	Engine Parts	840999	Engines; parts for internal combustion piston engines (excluding spark-ignition)	1,0	0,58	69

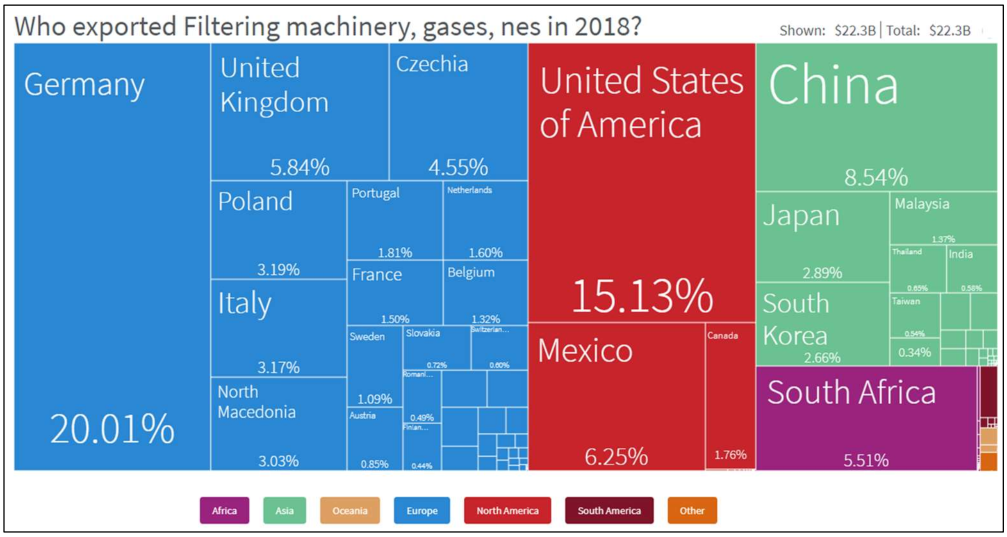


Figure 4-3 World exports of filtering machinery in 2018 from the OEC

The "Value Chain complexity ranking" column indicates the rank of the complexity of an activity according to all the activities in the generic South African automotive value chain. It is important to note that most of the activities contributing more than 80% of the generic South African automotive value chain have relatively low complexity values in comparison to the rest of the value chain. Therefore, it can be assumed that the automotive activities for which South Africa has an RCA do not need sophisticated capabilities, and the opportunity for structural growth with these activities will be challenging.

It is essential to focus on activities with relatively high complexity and opportunity gain to ensure the highest opportunity for growth; therefore, the analysis will now be focused on identifying such an activity for further analysis.

4.3 Choosing an activity for further development

In order to determine which activity offers the best opportunity for further development, an activity level analysis was done, which consisted of graphical analysis and comparing product space output variables. After the top activities were identified, it was also essential to consider the current direction of the global and local automotive industry to choose one activity for further analysis. The analysis commences with a graphical analysis.

The aim is to maximise complexity and opportunity gain and minimise distance; therefore, it is suggested that activities are considered systematically from top to bottom, as shown in Figure 4-4, which enables the comparison of activities in the same complexity and opportunity gain ranges. It can be seen that the complexity values and opportunity gain values are correlated with different distance values. Some activities have relatively low complexity and opportunity gain values with relative high distances (represented by the activities' colour). For example, the activity with HS code 870390 has the highest complexity and opportunity gain values but with a lower distance value (0,888) than the distance value (0,891) of activity with HS code 870911, which has lower complexity and opportunity gain values. The same for activities with HS code 840733 and 850780, with relatively low complexity and opportunity gain values, with relatively high distance values of 0,896 and 0,909, respectively. When graphically concentrating on the best complexity-opportunity gain combinations (black box), eleven top activities are evident. These eleven activities lie in a complexity range of 1,26 and 1,71 and opportunity gain of 0,36 to 0,56, with distance values between 0,882 and 0,907. Further analysis will now be applied to these eleven activities.

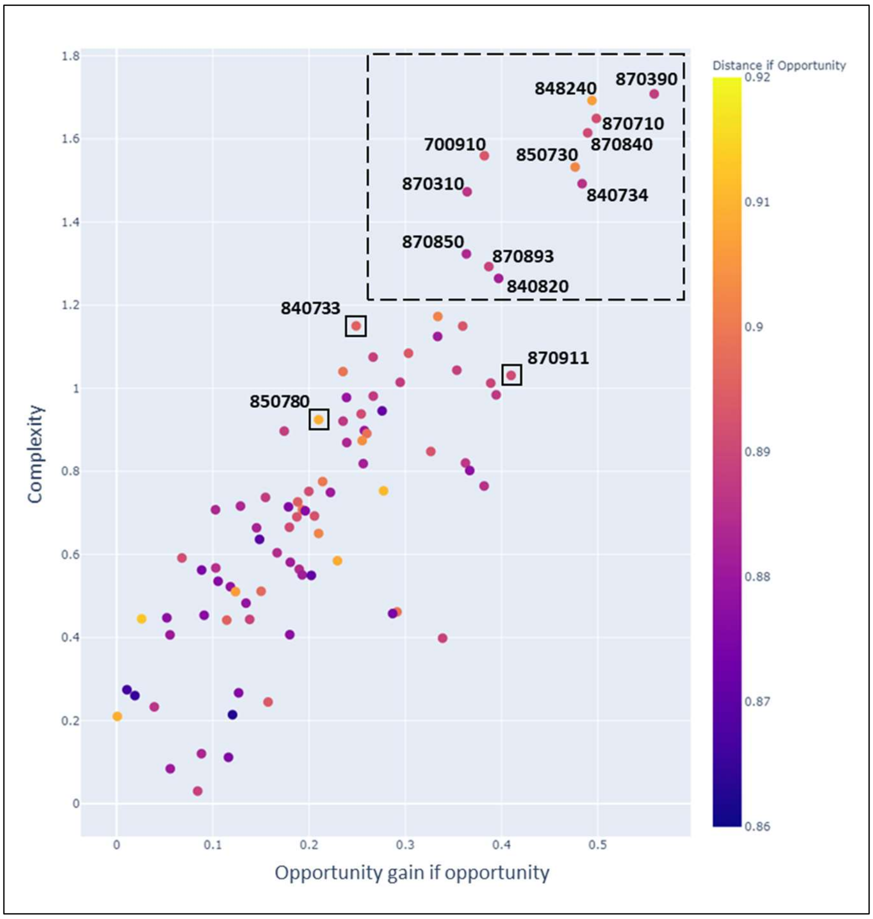


Figure 4-4 South African automotive activities presented graphically

The eleven identified activities can be seen in Table 4-3; the colour scales applied to the complexity, opportunity gain, and distance columns are based on the eleven activities identified, not the whole value chain, to clarify which activity would be the most optimal for further analysis. Also, note that the complexity percentage contribution is the percentage of the product's complexity of the total of the complexity values for the eleven products in the table. The opportunity gain and distance contribution values were calculated in the same way. The activities are sorted according to their complexity values from high to low. Components and parts threatened by the global move to electric and hybrid vehicles were excluded. Some of the ICE components (Figure 4-5) which could disappear from the value chain are engine parts, gearboxes and clutches, among others. (Kumalo, 2019) Therefore, gearboxes and reciprocating piston engines were removed from the current study (greyed out in Table 4-4).

The most apparent activity which could unlock potential is vehicles for the transport of persons (station wagons, racing cars, etc.) (HS code: 870390) with the highest complexity of 1,71 and opportunity gain of 0,56 and a relatively low distance at 0,888. Other activities with low distance values are drive-axles (HS 870850) and vehicles specifically designed for travelling on snow and golf cars (HS 870310), but these activities have the lowest complexity and opportunity gain values for this group. For example, the complexity and opportunity gain of vehicles for persons (870390) is respectively 29% and 55% higher than the same values for drive axles, and distance for vehicles of persons is 0,4% higher than the distance for drive-axles. Therefore, vehicles for travelling on snow, golf cars and similar vehicles and drive-axles will not be considered for this study.

In comparison, electric accumulators and glass have higher opportunity values. However, they are still far in contrast with the highest-ranking activities, which are 870390 (Vehicles for transport of persons), 848240 (Bearings) and 870710 (Vehicle bodies). Glass for rear-view mirrors has a relatively high complexity value, 1,56. However, relative to the other activities, the opportunity gain value of 0,38 is low, and the distance (0,893) is also higher than vehicle bodies, which has a higher opportunity value of 0,5. Bearings is second highest, but with the highest distance value of 0,907, which is the highest distance value for this group. Comparing vehicle bodies with bearings, the complexity and opportunity gain values of vehicle bodies are 1,65 and 0,5, respectively, which are relatively close to the bearing values but are considerably closer with a distance of 0,892. Therefore, vehicle bodies (870710) and vehicles for transport for persons (870390) were selected for further evaluation.

Table 4-3 Top eleven complexity-opportunity gain activities

Tier	HS Code	HS Code Description	Complexity	Complexity percentage contribution	Opportunity gain	Opportunity gain percentage contribution	Distance	Distance percentage contribution
1	870390	Vehicles; for transport of persons (other than those of heading no. 8702) n.e.c. in heading no. 8703, including station wagons and racing cars	1,71	10%	0,56	11%	0,888	9,06%
3	848240	Bearings; needle roller bearings	1,69	10%	0,49	10%	0,907	9,25%
2	870710	Vehicles; bodies (including cabs) for the motor vehicles of heading no. 8703	1,65	10%	0,50	10%	0,892	9,10%
2	870840	Vehicle parts; gear boxes and parts thereof	1,61	10%	0,49	10%	0,891	9,09%
3	700910	Glass; rear-view mirrors for vehicles	1,56	9%	0,38	8%	0,893	9,11%
2	850730	Electric accumulators; nickel-cadmium, including separators, whether or not rectangular (including square)	1,53	9%	0,48	10%	0,902	9,21%
2	840734	Engines; reciprocating piston engines, of a kind used for the propulsion of vehicles of chapter 87, of a cylinder capacity exceeding 1000cc	1,49	9%	0,48	10%	0,886	9,04%
1	870310	Vehicles; specially designed for travelling on snow, golf cars and similar vehicles	1,47	9%	0,36	7%	0,887	9,05%
2	870850	Vehicle parts; drive-axles with differential, whether or not provided with other transmission components, and non-driving axles; parts thereof	1,323	8%	0,364	7%	0,884	9,02%
2	870893	Vehicle parts; clutches and parts thereof	1,293	8%	0,387	8%	0,890	9,08%
2	840820	Engines; compression-ignition internal combustion piston engines (diesel or semi-diesel engines), of a kind used for the propulsion of vehicles of chapter 87	1,264	8%	0,397	8%	0,882	9,00%

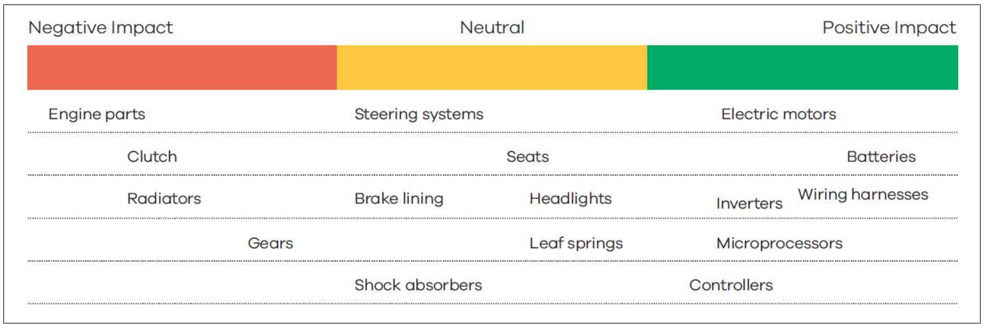


Figure 4-5 Impact of electric and hybrid vehicles on components (Kumalo, 2019)

Vehicles for transport of persons (870390)

The harmonised system classifies activity 870390 as vehicles for the transport of persons, which is not included in the public transport section and also not ranked in the passenger vehicle section and includes station wagons, hearses and racing cars. To understand where these HS codes fall within the HS system, the definitions of the heading and subheadings are in Table 4-4. The HS Code falls in chapter 87, which is classified as "Vehicles other than railway or tramway rolling stock, and parts and accessories thereof." The subheading, 8703, is classified as "Motor cars and other motor vehicles; principally designed for the transport of persons (other than those of heading no. 8702), including station wagons and racing cars." For ease of reference, subheading 8702 is classified as "Vehicles; public transport passenger type." For the H4 classification, which was launched in 2012, heading 8703 has nine subheadings, of which 870390 is the last subheading and a collection of all activities which does not fall within the other eight subheadings, also classified as "other". (WCO, no date)

Table 4-4 Classification of HS Code 870390

Classification	Heading	Description
H4	8703	Motor cars and other motor vehicles; principally designed for the transport of persons (other than those of heading no. 8702), including station wagons and racing cars
H4	870310	Vehicles; specially designed for travelling on snow, golf cars and similar vehicles
H4	870321	Vehicles; spark-ignition internal combustion reciprocating piston engine, cylinder capacity not exceeding 1000cc
H4	870322	Vehicles; spark-ignition internal combustion reciprocating piston engine, cylinder capacity exceeding 1000cc but not exceeding 1500cc
H4	870323	Vehicles; spark-ignition internal combustion reciprocating piston engine, cylinder capacity exceeding 1500cc but not exceeding 3000cc
H4	870324	Vehicles; spark-ignition internal combustion reciprocating piston engine, cylinder capacity exceeding 3000cc
H4	870331	Vehicles; compression-ignition internal combustion piston engine (diesel or semi-diesel), cylinder capacity not exceeding 1500cc
H4	870332	Vehicles; compression-ignition internal combustion piston engine (diesel or semi-diesel), cylinder capacity exceeding 1500cc but not exceeding 2500cc
H4	870333	Vehicles; compression-ignition internal combustion piston engine (diesel or semi-diesel), cylinder capacity exceeding 2500cc
H4	**870390**	**Vehicles; for transport of persons (other than those of heading no. 8702) n.e.c. in heading no. 8703, including station wagons and racing cars - OTHER**

In order to understand what falls under the "other" subheading 870390, websites with import-export information with HS codes and descriptions were studied; these included SEAIR (2020), Zauba (2018) and Exportimportstatistcs.com (no date). The information from the websites mentioned above can be seen in Table 4-5; it is essential to note that specific product descriptions traded on an HS code is limited; therefore, the information in Table 4-6 is not extensive. The US imported $86,4 billion on HS code 870390, and the top three countries for these imports are Japan (47,1%), Germany (19,4%) and South Korea (10,8%)(OEC, 2020). The US imports from Japan consisted of, amongst others, used vehicles (Mazda, Porsche, Audi and others) and passenger vehicles (Lexus and Toyota). The US imports from Germany included Porsche, Audi, Volkswagen Passat and the Lamborghini Urus. US imports from and exports to India include electric vehicles, although these are minimal percentages. From desktop research, it was found that electric vehicles imported into the US were "swept under the all-purpose 'Motor Vehicles – Other' code of HS8703.90"(Descartes Datamyne, 2017), but since the launch of the most recent HS classification in 2017, electric cars are now separately classified. Workman (2019) also confirms that there is no comparable data for electric cars before 2017.

Table 4-5 Imports, exports and descriptions of HS code 870390 (Exportimportstatistics, no date; ZAUBA, 2018; OEC, 2020; SEAIR, 2020)

Imports, exports and descriptions for 870390 (Product descriptions from Zauba, SEAIR and exportimportstatistics.com; Export values from OEC)	
Import or export countries	**Description of products**
US imports from India (0,016% of $86,4 billion imports of HS 870390 to USA)	Used vehicles (most frequent)
	Chairs and doors for Jeep Wrangler
	Volkswagen GTI Green
	Car Parts
US imports from Belgium (0,029% of $86,4 billion imports of HS 870390 to USA)	Lamborghini Urus
	Lamborghini Hurucan
	Porsche
US imports from Japan (47,1% of $86,4 billion imports of HS 870390 to USA)	Used vehicles (Mazdda, Porsche, Audi, Toyota Corolla, BMW, Volvo)
	Passenger vehicle (Lexus, Toyota)
US imports from Germany (19,4% of $86,4 billion imports of HS 870390 to USA)	Porsche/Porsche Macan
	Audi - most frequent
	Volkswagen Passat
	Lamborghini URUS
US imports from UK (0,25% of $86,4 billion imports of HS 870390 to USA)	Used vehicles (Volkswagen, Audi)
	Audi Q8
	Porsche Cayenne
Indian imports from Germany (2,16% of $55,4 million imports of HS 870390 to India)	E-Rickshaw - (most frequent)
	Electric vehicle
	BMW 320 DA
	BMW 730 LD

Therefore, it can be assumed that HS code 870390 is primarily used for used vehicles and luxury vehicles, and in the case of the United States, also electric vehicles. According to SARS, activity 870390 also includes ambulances and electric vehicles (Table 4-6), but according to 2017 trade data from SARS, 98% of exports for the activity fell under the 'other' section (Table 4-7) (SARS, no date).

Table 4-6 SARS description of HS Code 870390

SARS Tariff/HS Code	Description
87039025	Hearses
87039027	Ambulances
87039029	Electric vehicles
87039031	Electric vehicles smaller than 800kg
87039033	Other electric vehicles
87039090	Other

Table 4-7 Exports of HS code 870390 according to SARS

SARS tariff and description	Customs Value	Percentage of customs value
87039025 - Hearses	R39 275	0,01%
87039027 - Ambulances	R4 497 835	1,68%
87039090 - Other	R263 480 111	98,31%

This occurrence makes sense from a product space perspective because limited countries export luxury vehicles and electric vehicles. Also, there are a few noteworthy exporters of used vehicles, which include the EU, Japan and North America. Since HS code 870390 is used as a blanket code for everything that does not fall in the other subheadings of heading 8703, and there is limited information regarding the specific product which could improve structural growth, this code was not considered for further research in this study. The other HS code which showed potential regarding complexity and opportunity gain is vehicle bodies, which is discussed next.

Vehicle bodies for passenger vehicles (870710)

The other activity, 870710, is classified as vehicle bodies for passenger vehicles and includes cabs. The value of exports for body parts in 2017 was R10,7 million, whereas imports for body parts were R57,9 million (SARS, no date). After thorough research on global trade websites (ZAUBA, 2018; SEAIR, 2020), it was confirmed that body-in-white structures and body parts for passenger cars were traded using HS code 870710 (discussed in Section 5.2.1.). Therefore, body parts for passenger vehicles, including cabs (HS code: 870710), were chosen for further analysis and the location-centric framework will be applied to this activity.

Chapter 5

5 Location Determinants Evaluation Framework

After an activity had been identified using the I-O product space framework, it was possible to apply the location-centric framework to the activity. The methodology mentioned in Chapter 3.2 was followed to achieve this, and the results from applying this methodology are presented in this chapter. Firstly, the information regarding the activity was gathered (discussed in Section 5.1), then the industry and moderating factors for the industry were defined (Section 5.2). This was followed by analysing the market for the activity, including the market definition, market requirement definition and static market determinants (Section 5.3). The next phase consisted of analysing the location in terms of specific location determinants and moderating factors (Section 5.4). Finally, a dynamic analysis was applied, consisting of market-related dynamics, location related dynamics and interaction moderator factors (Section 5.5). Section 5.6 discusses the policy implications from the results of this analysis. The methodology for applying the LDEF can be seen in Figure 5-1.

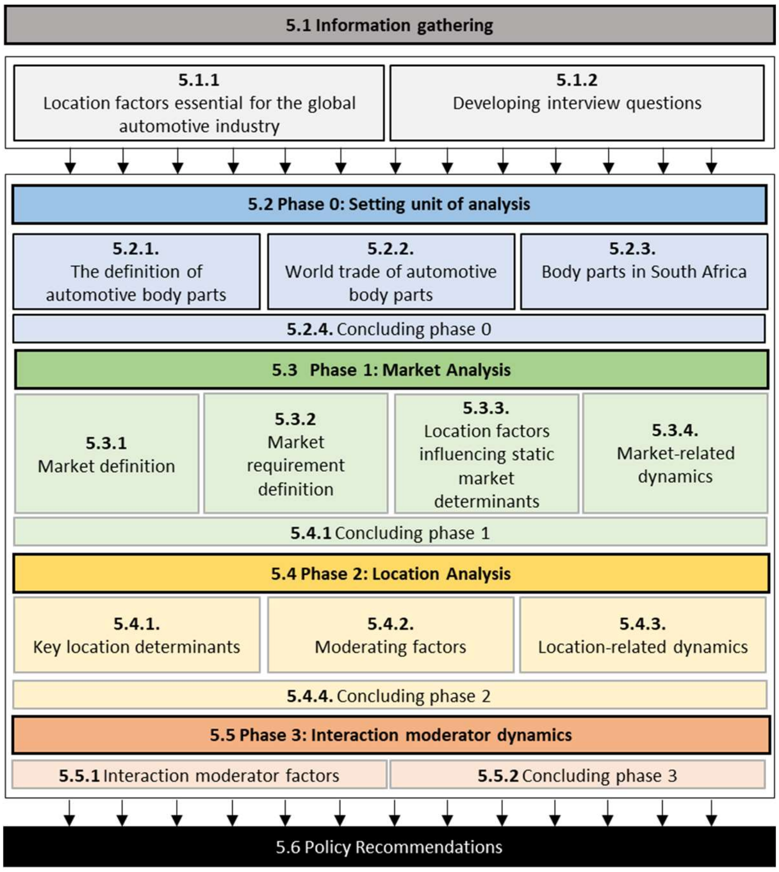


Figure 5-1 Methodology for the location determinants framework

5.1. Information gathering

Before starting with the location-centric framework, there was a need to gather the required information from industry experts in the automotive body part manufacturing industry. In order to achieve this, there was a need to ensure the questions directed at the industry experts are valid regarding location factors for the automotive industry; thus, research on the most critical location factors for the global automotive industry was required. This information, together with the location-centric framework, was then used to develop the questionnaire. The location factors essential for the global automotive industry (Section 5.1.1) and the survey development (Section 5.1.2) are discussed in this section.

5.1.1. Location factors essential for the global automotive industry

Considerable research has been done regarding location factors for the global automotive industry. The location factors most frequently discussed and mentioned in the literature studied arranged according to the LDEF themes can be seen in Table 5-1 (the location factors and the source of literature can be seen in (Appendix C). The most prominent location factors (mentioned more than five times in the 11 documents studied) are institutions and trust, nearness and quality of material inputs and suppliers, market access, knowledge spillovers, capacity changing and switching costs, skills and managerial skills availability, transport cost and lead time. Each of these is discussed in more detail below.

Firstly, regarding **institutions and trust**, the collaboration between OEMs are considered essential for success at a specific location, where joint ventures are preferred (Barnes and Kaplinsky, 2000b; PWC, 2018) and seen as a way to mitigate risk in developing countries (PWC, 2018). Furthermore, the importance of government support is also considered a key factor (Deloitte, 2018). Another theme is the **nearness and quality of material inputs and suppliers**, which relates to the quality and cost of raw materials available (Barnes and Morris, 2008; Ubillos, 2008; L. Alfaro *et al.*, 2012), where the reliability of suppliers (Barnes and Morris, 2008; Ubillos, 2008; Bennett and Klug, 2012) and technological innovation (Ubillos, 2008) are important factors. **Market access** is another theme discussed, where the physical access to large emerging markets is a vital location consideration (Paulo, Fusco and Spring, 2003; Bennett and Klug, 2012; L. Alfaro *et al.*, 2012). Proximity to customers (OEMs) (Barnes and Kaplinsky, 2000b; Bennett and Klug, 2012; Naude, 2013; Schmitt and Van Biesebroeck, 2013) and special economic zones (A. L. Alfaro *et al.*, 2012; Deloitte, 2018) are considered necessary for **knowledge spillovers** in the industry.

Table 5-1 Literature on location factors in the automotive industry (Sources: (Schmitt and Van Biesebroeck, 2013)(Bennett and Klug, 2012)(Naude, 2013) (Barnes and Kaplinsky, 2000a) (Paulo, Fusco and Spring, 2003) (Ubillos, 2008) (Guzman, 2015) (Barnes and Morris, 2008) (PWC, 2018) (Deloitte, 2018) (L. Alfaro et al., 2012))

	Location factor	**Aspects influencing location factor**
Cost	Labour costs and productivity	•Salary costs •Production efficiency •Employer employee relationship •Labour unrest
	Availability and cost of utilities	•Energy cost •Availability
	Capacity changing and switching costs	•Production lost •Changes in patterns of demand from OEMs •Planning failures
	Industrial Land	•Physical land available in automotive industrial parks
	Exchante rates/volatility	•A need for hedging exchange rate risks
	Infrastructure	• Administrative infrastructure (government processes) •Technology centers and engineering firms •Information flows •State of the art technology •Technological integration
	Institutions and trust	•Collaboration between OEMs and suppliers •Mitigate risk in emerging countries •Joint ventures preferred
	Managerial skills/skills availability	•Education of workforce in automotive industry •Scientists and engineers required
	Natural hazards based on geography	•Production interruption (war, environmental. Terrorist)
	Nearness and quality of material inputs and suppliers	•Special Economic Zones •Proper suppliers: quality, reliability, technological innovation, value for money •Quality and cost of raw materials (volatile) •Delivery reliability of suppliers •Working capital cost of raw material imports
	Tax structures	•Regulation risk
	Trade protection	•Protection of local suppliers
	Transport costs	•Delivery reliability •Infrastructure •Quality
	Lead time/Responsiveness	•Demand distance •JIT manufacturing
Market	High levels of competition to supply OEM	•High levels of competition to supply OEM •Firms competing for the same geographical market •Customer outsourcing choices
	Global economy and local economies	•Market fluctuations due to GDP, interest rates, fuel prices, etc.
	Customer development	•Effects of models released by OEMs
	Demand distance	•Proximity to OEM (cost)
	Market access	•Potential large emerging markets •Strong domestic market •Unemployment •Revenue potential •Adaptions for domestic market
	Good capital/financial market	•Access to credit •Ability to invest
Flexibility	Contracting environment	•Contractual flexibility for workers
Moderating factors	Economies of scale	•If economies of scale possible there exists a need for efficient logistic structure •Issue of proximity to customer versus ability to achieve economies of scale
	Knowledge spillovers	•Proximity and exchange of knowledge •Cross-industry value chains
	Resource intensity	•Resources determining location decisions
Policy Environment	Incentives, grants and subsidies	•Incentive systems (duty drawbacks) •Structural reforms
	Political and social tension	•Industrial disputes
Economic Environme	Economic environment	•Macro economic situation
Quality	Product quality	•Availability of quality components
	Cost of relocation	•Disinvestment
Product developmer	Innovation capabilities	•Investment in R&D

5.1.2. Developing interview questions

With a thorough understanding of the location factors considered globally, it was now possible to develop interview questions applicable to the body parts manufacturing industry. In conjunction with the considerations from the LDEF, the factors identified in the previous section were used to develop the interview questions. The moderating factors, location determinants, market definition and dynamics and location dynamics used to develop the questions are discussed below.

Moderating Factors

In order to determine which location factors are most important for the body parts manufacturing industry, there is a need to understand the moderating factors; therefore, the moderating factors from the LDEF were used to guide the interview questions (Table 5-2).

The moderating factors, the complexity of production processes, and technology intensiveness were grouped and probed in the interview under the current state of automation, planned automation, and automation cost in the industry. The dynamism of the product's market was understood by questioning the patterns of demand for the product and tooling upgrades required due to model changes. Different options were considered for knowledge spillovers, including proximity to OEMs, cross-industry value chains and SEZs. Regarding economies of scale, interviewees were asked if economies of scale are possible in South Africa and if needed to make manufacturing viable. In order to understand different experiences in different regions, the interviewees were asked how they experience different regions in the country in terms of ease of doing business, raw material availability and skills. Interdependence between different functions of firms was determined by understanding if different functions are performed at different locations to deliver the final product. For example, is one part manufactured at a different location to where the component is assembled. The other moderating factors, including the maturity of products, testability of the product, existing global footprint and testability of the product, were researched to understand the effect on the location factors.

Table 5-2 Moderating factors and corresponding to interview questions

	Moderating Factor	Impact on location decision making
Industry/product related firm	Complexity of production processes	Automation 1. The extent of automation of manufacturing processes in the industry 2. The industry automation planned for the next three years 3. Why is the industry at its current automation stage? 4. Why are there (no) planned automation for the next three years? 5. Cost of technology development in South Africa in comparison with the rest of the world?
	Dynamism of the product market environment	1. How often do patterns of demand from OEMs change? 2. Comment on the frequency of tooling upgrades due to new models released?
	How easy the type of knowledge employed is spilled over	What is considered important for knowledge spillovers for the industry? Options: proximity to OEMs, cross-industry value chains, industrial parks, SEZs, clusters, proximity to competitors, proximity to OEM R&D, systems integration with OEMs
	Maturity of products	N/A: determined through desktop research
	Economies of scale	1. Are economies of scale needed to make manufacturing of body parts in South Africa viable? 2. Are economies of scale possible in South Africa?
	Testability of the product	N/A: determined through desktop research
Firm related	Existing global footprint	N/A: determined through desktop research
	Experience in different regions	Does the industry experience different regions differently (i.e. are skills, raw material availability and ease of doing business different)?
	Interdependence between different functions in the firm	Are different functions to deliver the final product for the typical firm performed at different locations?
	Life cycle stage of the company	What is the lifecycle stage of body part manufacturers?
	Size of the Firm	N/A: determined through desktop research
	Technology intensiveness	See the complexity of production processes

Location Determinants

The most critical location success factors were discussed with interviewees, which include skills and raw materials. The availability of skills, cost of skill development and the availability for specific skills were discussed. In terms of raw materials, the availability and cost of raw materials in South Africa were discussed. The other location success factors that were rated in terms of importance are protecting local component manufacturers and relationships with governments and unions.

Market definition and dynamics

In order to understand how interviewees regard their market, the market for body part manufacturers was discussed in terms of how different markets have different market requirements. These also included the market dynamics of the LDEF, which included the perceived impact of environmental considerations on the body parts industry, the risk of alternative materials and access to SEZs. Interviewees were also asked to rate the importance of access to African markets, SEZs, and OEMs' relationship to the industry's success in South Africa.

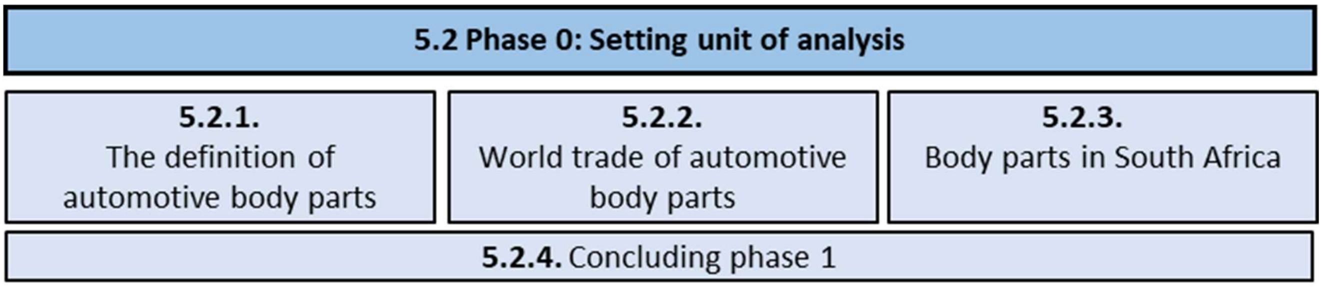
Location dynamics

The location dynamics were determined by asking interviewees what factors influence business development and investment decision in South Africa. Options, which include exchange rate volatility, the threat of expropriation, political risk or instability, risk of strikes, were given to interviews, but they had free reign to comment on other factors they regard as essential considerations. Supplier development was rated by the interviewees regarding the importance of the industry's success in South Africa.

The questions in the final questionnaire were submitted for ethical clearance, and after discussing the questions with an industry expert, the questionnaire was shortened to get focused answers and ensure the participants' time was used optimally. The final questionnaire, which was used to guide the interviews, can be seen in Appendix E.

With a high-level understanding of the global automotive industry location factors and inputs from industry experts, it was possible to start with phase 0 of the location-centric framework.

5.2. Phase 0: Setting the unit of analysis



The first step of the location-centric framework is setting the unit of analysis, which entails an activity and industry definition. According to Bam, De Bruyne and Schutte (2020), this step is "crucial" for this framework. Therefore, the automotive body parts are defined in this section (Section 5.2.1), after which the world trade of automotive body parts are discussed (Section 5.2.2), and finally, the body parts industry in South Africa (Section 5.2.3). Phase 0 is concluded with a summary in Section 5.2.4.

5.2.1. The definition of automotive body parts

The WCO defines the IO-PS framework's output (products with HS code 870710) as "Bodies (including cabs), for the motor vehicles of heading 8703." Motor vehicles under HS code 8703 are defined as "Motor cars and other motor vehicles principally designed for the transport of persons (excluding those designed for ten or more persons), including station wagons and racing cars." Thus, it can be assumed that the HS code is for bodies of passenger cars (including cabs). To understand the actual products traded on HS code 870710, products traded on the code were studied, as shown in Table 5-3. The table shows that body-in-white (BIW), bodies for motor vehicles, body assembly, body front and body shell, with two outliers, racing car kit and glass fibre accessories, are traded on this code. Therefore, it was deduced that passenger vehicle BIW and large structures of the BIW (for passenger vehicles) are the primary traded products on HS code 870710, as seen in Figure 5-2. All the parts used in the assembly of the BIW structure are listed in Appendix F. Manufacturers of BIW structures and assemblies, as suggested by NAACAM, were used for the analysis, and when "body parts" or "passenger body parts" are used in this study it refers to the assemblies and manufacturing of BIW. Manufacturers of smaller body parts were not considered for this study as these products are primarily traded on another HS code (HS870829) and not traded on HS870710 as in Table 5-3.

Table 5-3 Imports, exports and descriptions of HS code 870710 (Source: Exportimportstatistics, no date; ZAUBA, 2018; OEC, 2020; SEAIR, 2020)

Imports, exports and descriptions for 870710 (Product descriptions from Zauba, SEAIR and exportimportstatistics.com; Export values from OEC)	
Import or export countries (2018)	**Description of products**
US imports from South Africa (**12,1%** of 30,4M imports of HS 870710 to USA)	Mini bodies and parts
	Racing car kit
	Vehicle bodies
	Glass fibre body accessories - boating
US imports from Japan (**20%** of $30,4M imports of HS 870710 to USA)	Body assembly
	BIW
US imports from India (**3,53%** of $30,4M imports of HS 870710 to USA)	Body front
India imports from Germany (**39,7%** of $81,7M imports of HS 870710 to India)	Body skeleton
	Assembly BIW
	Bodies for motor vehicles
India imports from US (**10,2%** of $81,7M imports of HS 870710 to India)	Bodies for motor vehicles
	Assembly white body
India imports from Japan (**4%** of $81,7M imports of HS 870710 to India)	Body shell

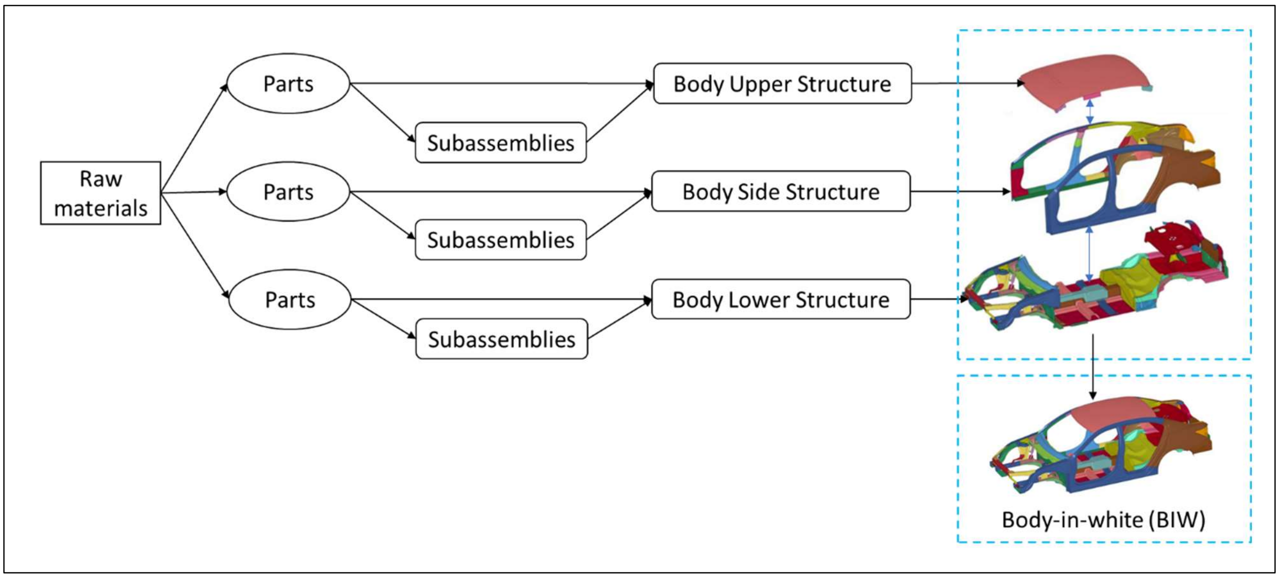


Figure 5-2 Representation of parts, sub-assemblies and structures of a body-in-white (BIW) (Sources: Shalash, 1996; Klinger, 2012)

Body-in-white refers to the end product after all the car body's sheet metal components are welded together before the body has been painted (Disenosys, no date). BIW represents 23-28% of the weight of a vehicle; therefore, numerous studies on vehicle bodies in terms of mass-reduction technology have been conducted to build an optimal vehicle in terms of fuel consumption and emission standards (MarketsandMarkets, 2019), but still ensuring the structural integrity of the body (Lutsey, 2010). With a focus on lightweight and anti-corrosion materials, it is predicted that aluminium will increasingly be applied in BIW manufacturing (Research and Markets, 2017). Materials currently used for the body are steel, aluminium, magnesium and carbon fibre reinforced polymers (CFRP), and the main manufacturing methods are cold stamping, hot stamping and roll forming (MarketsandMarkets, 2019).

5.2.2. World trade of automotive body parts

The automotive body's manufacturing processes' high capital requirement is the primary barrier to entry to body part manufacturing (Research and Markets, 2017; MarketsandMarkets, 2019). However, the global market for BIW for the automotive industry (including passenger vehicles, electric vehicles, light commercial vehicles and medium & heavy commercial vehicles) is estimated at a 2% compound annual growth rate (CAGR), which translates to an increase of \$20,5 billion from \$77 billion in 2019 to \$90,5 billion in 2027. Although global passenger vehicle sales are down, the rest of the automotive industry sales are expected to grow, and with the increased development of electric vehicles, more attention will be focused on more optimal manufacturing and lightweight material solutions. (MarketsandMarkets, 2019)

Body parts for passenger carrying vehicles (HS 870710) were the 896th most traded product globally in 2018 out of 4726 products, with a \$3,42 billion value. Eleven countries contribute to most of the global exports of body parts, where the top three countries exporting body parts in 2018 were the USA, Spain and Germany, who contributed 31,1%, 12,9% and 11,9% respectively to global exports (Table 5-4). Regarding imports, the top importers were Netherlands, Algeria and Russia, who contributed 27,4%, 16,3% and 11,2%, respectively, to global imports. It is important to note that most global trade in body parts is in the northern hemisphere. The reason for this is the high costs of transport due to the weight of body parts. Also, the further the distance to markets is from the source, the higher the chance of damage to vehicle body parts are. (OEC, 2020)

Table 5-4 Top exporters and importers of body parts (HS 870710) (OEC, 2020)

Top 3 exporters of HS87071 in 2018 Total world trade of HS870710 in 2018: \$3,42B	**Percentage of exports**	**Top 3 importers from respective exporter**
USA (Export value: \$1,06B)	31,10%	Netherlands (87,3%) Russia (5,15%) Malaysia (1,52%) of 1,6B
Spain (Export value: \$441M)	12,90%	Algeria (90,6%) Morocco (3,49%) India (1,5%)
Germany (Export value: \$405M)	11,90%	UK (36,4%) Italy (11,3%) India (8%)

5.2.3. Body parts in South Africa

Passenger vehicle body manufacturers (BIW) in South Africa are tier 1 MNCs and supply directly to the local OEMs. The South African multi-national BIW suppliers and their origin can be seen in Table 5-5 below. BIW is too heavy to make imports viable; smaller body parts for subassemblies (which does not affect the body's structural integrity) are imported because the quality requirements for these products are not as strict and can be sourced at lower costs from international suppliers selected by the OEM. The body part manufacturers manufacture structural parts that are too heavy to transport or could be damaged when shipped over large distances.

Table 5-5 Body part manufacturers based in South Africa

Representatives contacted from the following institutions/firms	Institution/Firm	Assembly/ subassembly of BIW	Origin Country	Plant based in South Africa
Voestalpine Group	Body part manufacturer	x	Austria	✓ (East London; Pretoria)
Benteler International	Body part manufacturer	✓	Austria	✓ (Uitenhage - PE; Alberton)
CLN Group - MA Automotive	Body part manufacturer	✓	Italy	✓ (PE; East London)
Sodecia Automotive	Body part manufacturer	✓	Germany	✓ (Pretoria)
Linde + Wiemann RSA (Pty) Ltd	Body part manufacturer	✓	Germany	✓ (PE; East London)

5.2.4. Concluding phase 0

This phase of the framework considered the IO-PS output and defined the body parts manufacturing industry as passenger vehicle BIW structures and assembly. The global trade of automotive body parts is concentrated in the northern hemisphere due to the physical nature of the product. In South Africa, body part manufacturers are MNCs supplying the seven OEMs who assemble passenger vehicles. In the following section, the market for body parts will be analysed.

5.3. Phase 1: Market analysis

5.3 Phase 1: Market Analysis			
5.3.1 Market definition	**5.3.2** Market requirement definition	**5.3.3.** Location factors influencing static market determinants	**5.3.4.** Market-related dynamics
5.4.1 Concluding phase 1			

After defining the industry and the firms producing passenger body parts, the market needs to be defined. The process as described by Bam, De Bruyne and Schutte (2020) will be used to analyse the market; firstly, the market was defined (Section 5.3.1), then the requirements demanded by the market were defined (Section 5.3.2), the effect of location factors on the market was studied (Section 5.3.3), and finally, the market-related dynamics were considered (Section 5.3.4). Phase 1 is concluded with a summary in Section 5.3.5.

5.3.1. Market definition

There is a need to define the market to understand how location decisions could affect the market accessible from a particular location. Therefore, the market size (Section 5.3.1.1), the size of markets with similar tastes (Section 5.3.1.2), the sophistication of customers (Section 5.3.1.3), the representativeness of local customer requirements of the firm's market (Section 5.3.1.4) and market congruence with the markets at the location under study (Section 5.3.1.5) were considered.

5.3.1.1. Market size

Firstly, it is essential to understand how big the market for body parts accessible from South Africa is. For the body parts manufacturers, the direct customers are the seven OEMs based in South Africa. Due to the size of assembled body parts and fragility (paint is easily scratched on outer panels), proximity to OEMs is crucial, a competitive advantage (industry expert E) for body part manufacturers already based in South Africa. Thus, all the light vehicle manufacturers in South Africa source large and structural body parts from first-tier suppliers based in South Africa.

Regarding body parts for passenger vehicles, 348 665 units were manufactured in South Africa in 2019 (Lamprecht, 2020), which translate to the BIW demanded from large body part manufacturers in South Africa by OEMs. In 2019 the imports of body parts (HS 870710) were R58,8 million, mainly from Canada, the USA and China. In the same year, exports for body parts were R10,6 million, mainly to the UK, Australia and Namibia (SARS, no date). Although HS code 870710 is also used to import and export aftermarket parts, it is impossible to determine from the data available what exactly is imported or exported on the code.

The demand volumes for body parts are also indirectly impacted by the demand for passenger vehicles, but volumes are fixed for 3- or 7-year projects because a new passenger vehicle model is launched every seven years with a possible facelift at the 3-year mark. Passenger vehicle sales contributed 66,2% (355 378 units) of the new vehicle market in South Africa. Regarding the foreign market demand for passenger vehicles, 260 843 units were exported to 105 different destinations, which accounted for 67,4% of vehicle exports in 2019. The top five destinations for South African produced light vehicles (passenger cars and light commercial vehicles) volumes are UK, Germany, Japan, France and Australia, whereas Germany is the top automotive trading partner (imports and exports) regarding value. (Lamprecht, 2020)

Another market for body parts is the aftermarket, where parts that are not directly sourced from OEMs are sold to owners of vehicles outside their warranty period. Feedback from an aftermarket body part supplier states that aftermarket body parts (small or large) are not available locally; therefore, all aftermarket body parts are imported. Imported aftermarket body parts are also low cost and bought at wholesale prices.

It is important to note that with current production volumes, there are production inefficiencies within large body part manufacturing; therefore, it can be assumed that the OEM market for locally manufactured large body parts is saturated in South Africa.

5.3.1.2. Size of markets with similar tastes

As mentioned in Section 5.3.1.1, the body part manufacturing industry is dependent on the OEMs' volumes and therefore indirectly influenced by passenger vehicle sales. Therefore, for the definition of the size of markets with similar tastes, the taste for passenger vehicles will be considered. Light vehicle production increased from 2015 to 2019 by 3,3%, and the percentage of production exported increased by 7,1% during the same period; it is therefore evident that the increased production was exported, and exports also absorbed the decreased local demand. The biggest markets with similar tastes to the South African domestic market for passenger vehicles are Germany, the USA, Japan and Sub-Saharan Africa (SSA) (Lamprecht, 2020).

Therefore, it can be assumed that the countries mentioned above will also demand body parts for light vehicles. When considering the demand for body parts in Germany, the USA and Japan, body parts will be traded between countries in the northern hemisphere due to the cost inefficiencies of body parts over long distances.

The sub-Saharan African market is dominated by pre-owned vehicles from Japan and North America at uneconomical prices; this, combined with deteriorated SSA economies and limited access to credit, limits the possibility of regional value chains in SSA. Still, according to demographic studies, it is predicted that there will be considerable middle-class growth in SSA in the coming 15 years (Black *et al.*, 2018). Regarding body part exports from South Africa, the top African importing countries in 2019 were Namibia (R1,33 million), Botswana (R1,06 million) and Lesotho (R344 thousand) (SARS, no date), although these exports are most probably aftermarket parts because there are no OEMs (which is based in South Africa) based in these countries. Regarding the market for aftermarket body parts in SSA, it will be more cost-effective to import from China or Taiwan.

From the value of vehicle exports to Germany, the USA, Japan and SSA, it can be deduced that there are markets with similar tastes to South Africa. The sophistication of customers will now be discussed.

5.3.1.3. The sophistication of customers in markets

The uniformity of each vehicle across the globe in terms of the quality of raw materials and the quality standards at which each vehicle is produced and assembled is one of the automotive OEMs' key competitive strategies (Industry expert C). The uniformity of vehicles in conjunction with OEMs' very high standards regarding quality and the adoption of technology to acquire the desired quality levels indicates that the OEMs are sophisticated customers. Global competitors of OEMs drive their sophistication.

5.3.1.4. Representativeness of local customer requirements of the firm's market

Due to established relationships and trust between OEMs and tier 1 suppliers, the multi-national body part suppliers usually also supply to the same OEMs in different markets across the globe. Therefore, the market requirements are the same as in South Africa, and, as mentioned earlier, a competitive advantage of OEMs is the uniformity of their products.

The environmental requirements for production are less stringent than in Europe. However, there has to be conformity to European environmental requirements for the body parts specifically because high volumes of passenger vehicles produced in South Africa are exported to Europe (Industry expert F). This also applies to the tooling needed for specific models; as most car models are also exported to European and Asian markets, the tooling used in body part manufacturers' plants across the globe can be used in South Africa.

Therefore, it can be assumed that the global OEM requirements are the same as in South Africa. The market requirement for customers of body parts in South Africa will now be discussed.

5.3.2. Market requirement definition

The automotive body parts market is defined as the seven OEMs manufacturing passenger vehicles in South Africa. It is important to understand the "key requirements" needed (Bam, De Bruyne and Schutte, 2020) by OEMs to understand if South Africa meets the requirements. Therefore, the performance dimensions of the OEMs will now be discussed.

Performance dimensions

The body parts industry falls in the manufacturing customer segment and the performance metrics considered according to Bam, De Bruyne and Schutte (2020) are thus cost, quality, service level, flexibility, lead time, responsiveness and environmental impact.

To track industry trends and assess the South African automotive industry's performance and ensure transparency of the industry's position with stakeholders, B&M Analysts SA (Pty) Ltd. compiles the South African Automotive Supplier Performance Report for Naacam (B&M Analysts, 2020).

Performance metrics considered are Price, Quality, Reliability, Flexibility, Product development. The results regarding the performance requirements (drivers) for the seven OEMs based in South Africa can be seen in Table 5-6 below. B&M Analysts SA (Pty) Ltd. uses a Customer Benchmark Index (CBI) percentage to rate how important the drivers are. The most critical performance metric for OEMs is Price (40%), but it rates the lowest in terms of the CBI performance score from 2017 to 2019 compared to the rest of the drivers. Price and Flexibility ratings declined from 2018 from 86,32% and 91,18% to 83,76% and 90,29% in 2019, respectively (Figure 5-3). The other metrics' CBI score increased each year, which could be the reason why the price driver increased as this metric possibly absorbed the cost of improved quality, reliability and product development.

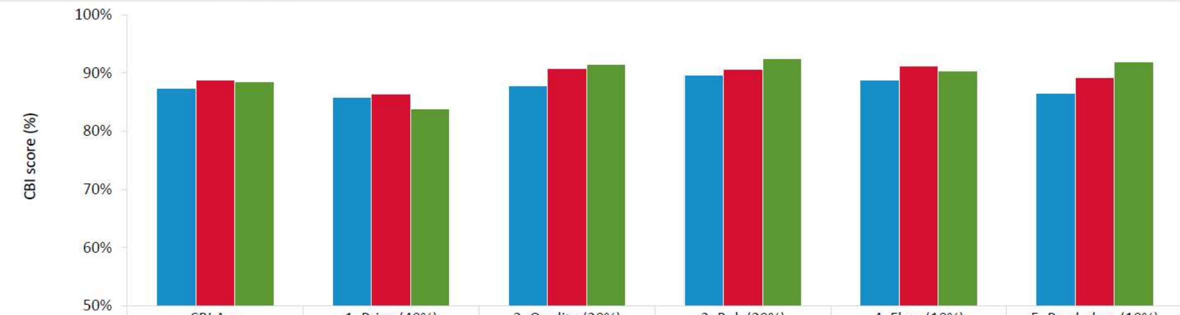
Table 5-6 Drivers for performance for South African OEMs (B&M Analysts, 2020)

Drivers**	Performance criteria	
1. Price (40%)	• Price	
2. Quality (20%)	• Quality of products	• Products' conformance to standards
3. Reliability (20%)	• Delivery reliability • Responsiveness to problems	• After sales support/service
4. Flexibility (10%)	• Delivery frequency • Communication flow from contacts	• Lead time flexibility • Geographical proximity
5. Product development(10%)	• New product development/ modification capacity	• Capacity to undertake process innovation

* This section contains the aggregated responses for the seven local OEMs. The customer responses for each local OEM are averaged separately before calculating the SA OEM figure

** The Customer Benchmark Index (CBI) percentage for each market driver (i.e. Reliability) is calculated by categorising the more granular performance criteria (i.e. if customer requires 10, and rates firm at 8, the CBI score will be 80%), with the overall CBI average calculated by weighting the drivers as per the % shown in brackets

SA OEM (n=7) – CBI summary assessment



	CBI Avg	1. Price (40%)	2. Quality (20%)	3. Rel. (20%)	4. Flex. (10%)	5. Prod. dev. (10%)
SA OEM 2017	87.34%	85.83%	87.72%	89.65%	88.79%	86.55%
SA OEM 2018	88.84%	86.32%	90.72%	90.67%	91.18%	89.14%
SA OEM 2019	88.51%	83.76%	91.48%	92.47%	90.29%	91.89%

* Number in brackets indicate driver that customer criteria are allocated to for CBI assessment – (1) = Price, (2) = Quality, (3) = Reliability, (4) = Flexibility and (5) = Product Development

Figure 5-3 CBI assessment by OEMs for 2017 to 2019 (B&M Analysts, 2020)

This section's performance metrics will support decision-making regarding the importance of the location success factors discussed in phase 2. The performance metrics have been adapted from Bam, De Bruyne and Schutte (2020) and B&M Analysts (2020), as discussed in Section 3.2.3.2. The location factors which affect the market for body parts will now be discussed.

5.3.3. Location factors influencing static market determinants

In order for companies to understand the markets accessible and for governments to understand how markets can be developed and sustained, there was a need to understand which location factors could influence market determinants. These location factors, including geography (Section 5.3.3.1.), per capita income (Section 5.3.3.2), historical development (Section 5.3.3.3.) and the geopolitical situation (Section 5.4.4.3.) (Figure 5-4), will now be discussed.

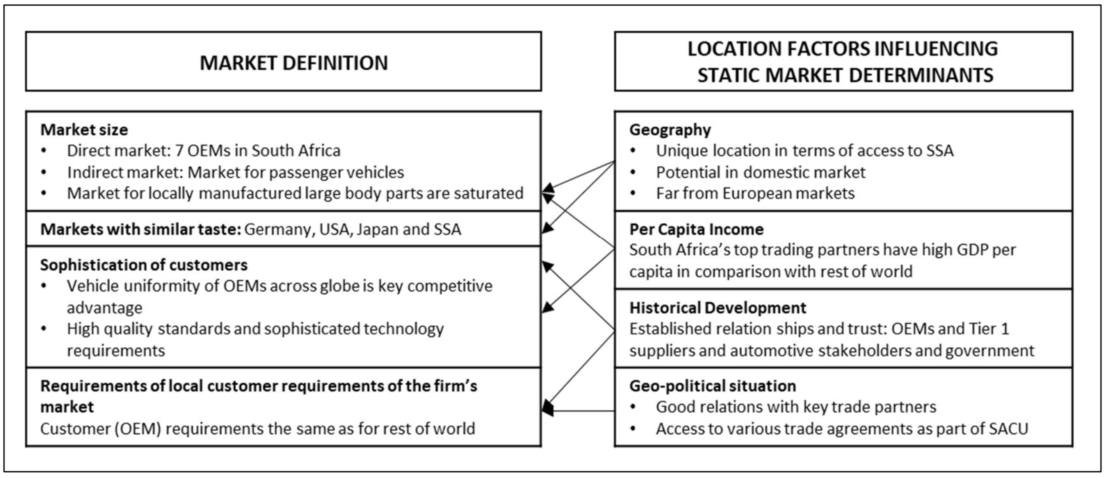


Figure 5-4 Location factors influencing the market for body parts

5.3.3.1. Geography

In terms of geography, South Africa has access to the sub-Saharan African (SSA) market, and according to Black et al. (2018), South Africa is in an exclusive position to develop a business case for the development of an automotive value chain in SSA. The success of such a value chain depends on mutual benefits to South Africa and the SSA countries. (Black et al., 2018)

There is still potential in South Africa regarding the domestic market, having a value of 6,3 people per vehicle in operation compared to mature markets where people per vehicle in operation are typically between 1,3 and 2,0 (Black *et al.*, 2018).

A considerable part of light vehicle production in South Africa is mainly exported to Europe, the USA and Japan, which is a concern in terms of the demand distance. South Africa is geographically far from its global importers.

5.3.3.2. Per capita income

The volumes for body parts are indirectly influenced by the local demand for passenger vehicles and the volumes of passenger vehicles exported. The cost of tooling requires great investments from OEMs and tier 1 suppliers, and economies of scale are necessary to make investments profitable (Industry Expert E). The higher the demand for passenger vehicles, the more production efficiencies will be obtained (Industry Expert E). The South African economy contracted by 1,4% in 2019, and manufacturing contracted by 1,8% due to reduced motor vehicles and transport equipment, among others, being produced (Stats SA, 2020a). A 16% GDP reduction in the first two quarters of 2020 was reported due to the COVID-19 impact on the South African economy (Stats SA, 2020b).

Regarding the GDP per capita of South Africa's largest light vehicle export markets, Japan, Germany, and the UK ranked 17th ($49 188), 18th ($47 628) and 27th ($43 688), respectively, in the world. South Africa ranked 85th in the world with a GDP per capita value of $7 346. (Trading Economics, 2019) When considering income per capita, it is also essential to keep in mind that South Africa has the highest Gini coefficient in the world (0,62), whereas Japan, Germany and the United Kingdom have Gini coefficients of 0,34, 0,29 and 0,37, which gives more insight on the size of the markets South Africa trades with (OECD, 2020). Concerning the regional market, SSA had a GDP per capita of $1 585 in 2019 (macrotrends, no date).

The state of the South African economy, which relates to the per capita income, directly influences the sale of new passenger vehicles and, therefore, an indirect impact on the market for body parts. South Africa's most significant trading partners in light vehicle consumption (Japan, Germany and the UK) are rated in the top 30 for GDP per capita, with lower income inequality than South Africa. On the other hand, South Africa's regional partners (SSA) have a considerably lower GDP per capita.

5.3.3.3. Historical development

A concurrent theme in the global automotive industry is the relationship and trust between OEMs and tier 1 suppliers, and tier 1 body part manufacturers follow in the OEMs' footsteps. If an OEM opens a new plant in a location where the body part manufacturer is not yet situated, they will, depending on their contracts with the OEM, most possibly also move to this location (Industry expert A). The relationship between government and automotive stakeholders has also been critical to the industry's success, and industry experts comment that the industry has had considerable support from the government to make South Africa an attractive location for automotive manufacturing (Industry experts: A, B and E).

5.3.3.4. Geo-political situation

After the Apartheid related sanctions against South Africa were lifted, South Africa has had good relations with global trade partners and had 151 export destinations in 2019 (export value above R 1 million per country), with Germany being the top export trade partner and India being the top import trade partner of 25 import destinations. (Lamprecht, 2020)

South Africa has bilateral trade agreements with most of its key trading partners and further improves its global trade by participating with regional partners in the South African Customs Union (SACU), including Botswana, eSwatini (Swaziland), Lesotho and Namibia. Currently, SACU has free trade agreements with the 28-country European Union and the European Free Trade Association (EFTA), including Iceland, Lichtenstein, Norway and Switzerland. SACU is also part of the Southern African Development Community (SADC) free trade area and has a preferential trade agreement (PTA) with Mercosur, including Argentina, Brazil, Paraguay, and Uruguay and Venezuela. As part of the African Growth and Opportunity Act (AGOA), a unilateral trade preference program, South Africa has duty-free and quota-free access to the US market. (Lamprecht, 2020)

5.3.4. Market-related dynamics

In this section, the factors that could affect the sustainability of the market for body parts will now be discussed. These include migration/firm relocation (Section 5.3.4.1), demographic changes (Section 5.3.4.2.), market segment taste changes (Section 5.4.3.4), social development (Section 5.3.4.4.) and political dynamics (Section 5.3.4.5) (Figure 5-5).

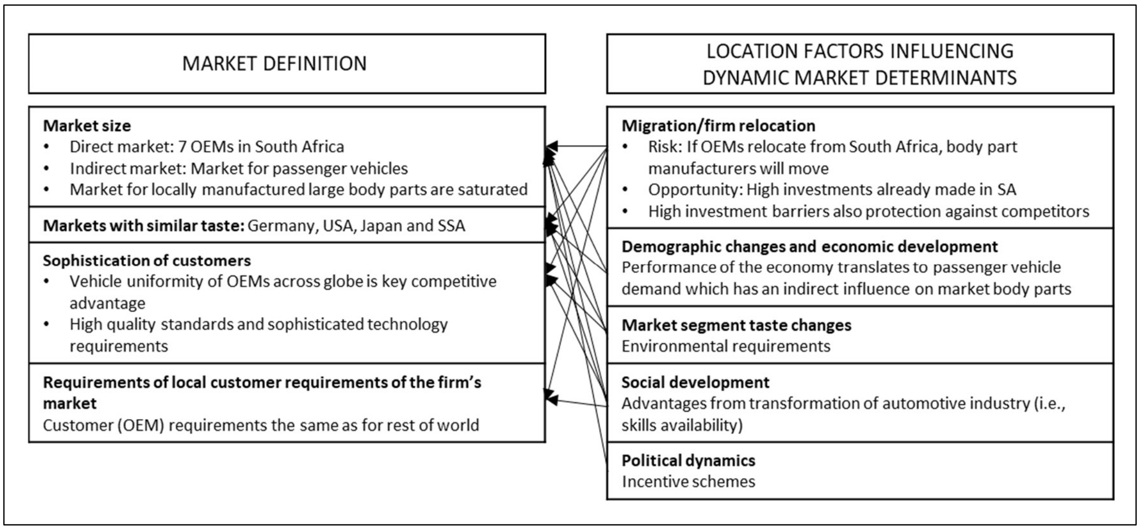


Figure 5-5 Market-related location dynamics affecting the market for body parts

5.3.4.1. Migration/firm relocation

Industry expert B states: "The component suppliers are dependent on the OEMs for their existence in SA while the OEMs generate the export contracts for these suppliers." Industry expert E also commented: "If OEMs leave, then the component manufacturers will also leave, like the Australia situation" Australia tried to develop an export-oriented automotive industry when the domestic volumes could not sustain the industry, but they lost the automotive industry as a whole (Black *et al.*, 2018). Black et al. (2018) note that one of the South African industry's strengths is the established automotive OEM base with considerable sunk costs. Industry expert E agrees with this, commenting that the tooling investments and the cost spent on current projects do not make relocation of OEMs viable. High investment barriers are also competitor barriers in the body part industry, and the risk of competitors relocating to South Africa is low (Industry expert E).

5.3.4.2. Demographic changes and economic development

The economy's future performance is an indication of unemployment, poverty, and education levels of the general population. The South African economy has been struggling and went into recession at the end of 2019; also, the full impact of the COVID-19 pandemic on South Africa's economy and the demand for passenger vehicles and, in return, the demand for body parts cannot be determined.

5.3.4.3. Market segment taste changes

In terms of global trends, the most noteworthy is the movement towards more environmentally conscious manufacturing processes and vehicles, although exactly how processes will look and what developments will be implemented are still uncertain. A certainty is increasing environmental regulation, and OEMs will progressively implement these regulations with each model change (typically every seven years). These implementations will include improved structural and BIW materials for lighter and more easily recyclable vehicles, which will also aid in more fuel-efficient vehicles. (Black *et al.*, 2018)

5.3.4.4. Social development

One of the SAAM's objectives is transforming the South African automotive value chain, including developing second- and third-tier black-owned automotive component and raw materials manufacturers and developing black technical, professional and management skills at OEM and Tier 1 levels. This transformation should positively impact OEMs and component suppliers, as there will be more individuals available with the required skills.

5.3.4.5. Political dynamics

Local market determinants do not drive the demand for vehicles. However, exports are motivated by compensating for cost disadvantages in the form of AGOA, EU-SA FTA and the APDP benefits (Black *et al.*, 2018). Thus, the automotive policy regime is a vital determinant of the markets for passenger vehicles and, in return, body parts, reiterated by industry expert B, "Nothing happens in isolation in the SA automotive industry, everything relates back to the policy regime".

The location factors that could change the future or impact planned project viability and affect the market as defined in Section 5.3.1 were discussed. There is the risk of OEMs relocating, which would lead to first-tier suppliers also leaving the country, but an asset for South Africa is that these stakeholders have made high investments, and relocation would not make financial sense at this point. The industry is defined by high entry barriers that give the current body part manufacturers an advantage in South Africa. One of the most concerning factors regarding the size of the market for body part manufacturers is the indirect domestic demand for passenger vehicles defined by demographic changes and economic development. A global trend with the most significant impact on markets will be the global move to more sustainable and environmentally-friendly vehicles, and focusing on staying relevant in terms of this trend is crucial. The impact of planned transformation should have a positive effect on skills availability and unemployment rates. Finally, and most importantly, the South African automotive industry is very dependent on incentive schemes in South Africa to make a viable business case for being located in South Africa.

5.3.5. Concluding phase 1

In this chapter, the first phase of the LDEF was used to analyse the automotive body parts market. The first phase consisted of defining the market, defining the market requirement and defining static and dynamic market determinants (Figure 5-6).

The **market for large body parts manufactured in South Africa** has been defined as the seven automotive OEMs in South Africa, and the indirect market has been defined as the market for passenger vehicles. It was also concluded that the market for body parts manufactured in South Africa is saturated due to economies of scale not currently possible for local body part manufacturers. The **market requirement** has been defined, and the most critical performance determinants as rated by OEMs in South Africa are price (40%), quality (20%) and reliability (20%), flexibility (10%) and product development (10%). The market was defined, and static and dynamic market determinants that could influence the market was discussed. **Static market determinants** that influence the market for body parts have been discussed, including geography, the per capita income of the main trading partners, historical development, and South Africa's geo-political situation. Finally, to understand **market-related dynamics** in the automotive body part industry, the location factors that could affect the market, in the long run, were discussed. These include migration or firm relocation, demographic changes and economic development, market segment taste changes, social development and political dynamics. The second phase of the LDEF will be discussed in the next section.

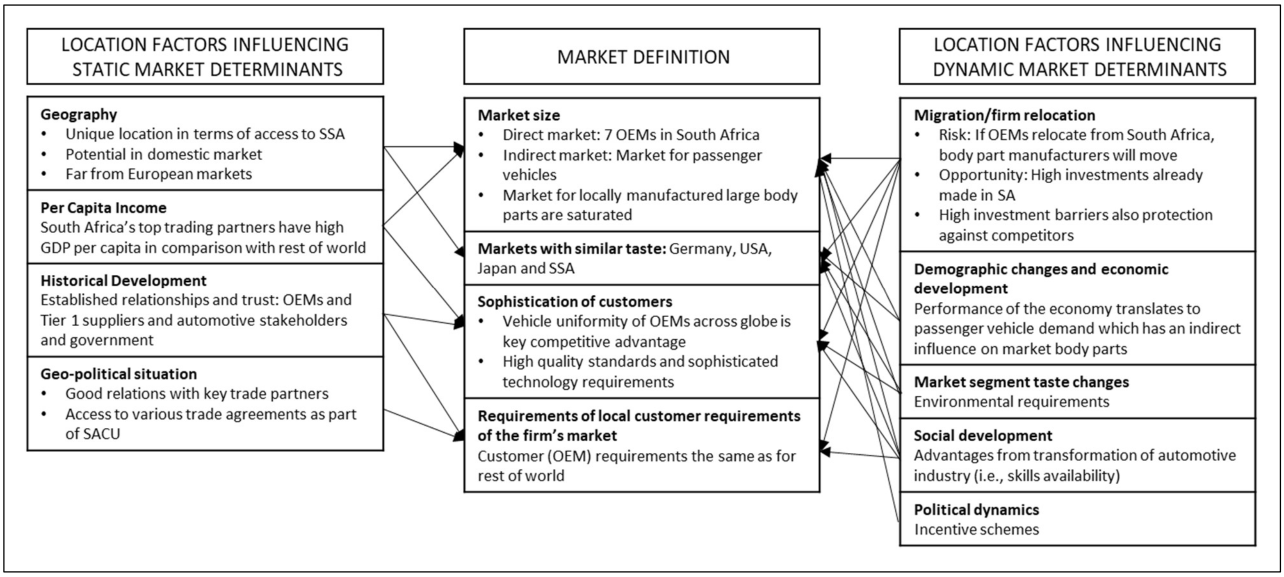
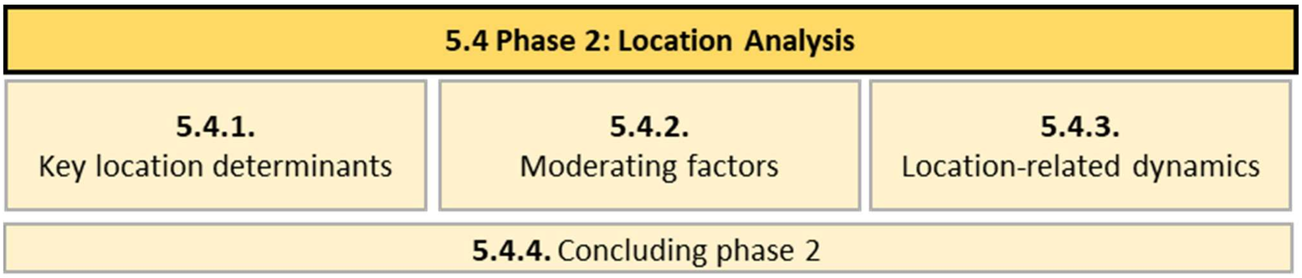


Figure 5-6 Summary of market analysis

5.4. Phase 2: Location analysis



After the market for body parts had been defined, market determinants determined, and market dynamics were discussed, it was necessary to understand the location success factors. These location factors are discussed in Section 5.4.1; then, the moderating factors are described to understand which location factors are the most important to the body parts industry (Section 5.4.2). Finally, the dynamic location factors that could affect the body part manufacturers' ability to satisfy customer needs in the future were discussed (Section 5.4.3). This phase is concluded with a summary in Section 5.4.4.

5.4.1. Key location determinants that influence activity-related performance

As suggested by Bam, De Bruyne and Schutte (2020), the location factors and location factors determined by desktop research (Section 5.1.1.) were used as a basis for the analysis of location success factors. These factors can be seen in Table 5-7; the CBI percentage for each market requirement is defined in Section 5.3.2. The relationship between the location factors and the market requirements is highlighted in grey. These location success factors are directly or indirectly linked to the body part manufacturers' ability to satisfy customer needs. For example, skills availability is linked to the cost, quality and flexibility of market requirements. If the required skills are not available at a particular location, the cost of skills could be high for the required expertise as the demand for skilled workers is high, and supply is low. Quality levels might not be attained because unskilled labour does not have the necessary expertise, and employers will not have flexibility in terms of having employees available on the chance of employees falling ill or resigning. The location factors applicable to the automotive body parts industry will now be discussed regarding their influence on the performance dimensions.

Labour costs and productivity

Industry expert C commented that labour productivity in South Africa is low compared to Europe; the ratio of people needed in SA versus Europe to do a specific task is much higher. Wage negotiations in South Africa are scheduled for every three years, and wages would then be fixed for the next three years (industry expert C and E). Passenger vehicle model projects usually run for seven years, which means that wage negotiations would happen twice during a project, which is seen as a risk because the capital outlay is planned at the beginning of a project and body part manufacturers run the risk of losing profit due to increased wages. Labour with the required skills and experience are very expensive and even more expensive than the same skills and experience of labour in Europe (Industry Expert F).

Exchange rates

The manufacturers of big/structural body parts are more concerned with the fluctuations of exchange rates discussed in the location dynamics section (Section 5.4.3).

Trade protection

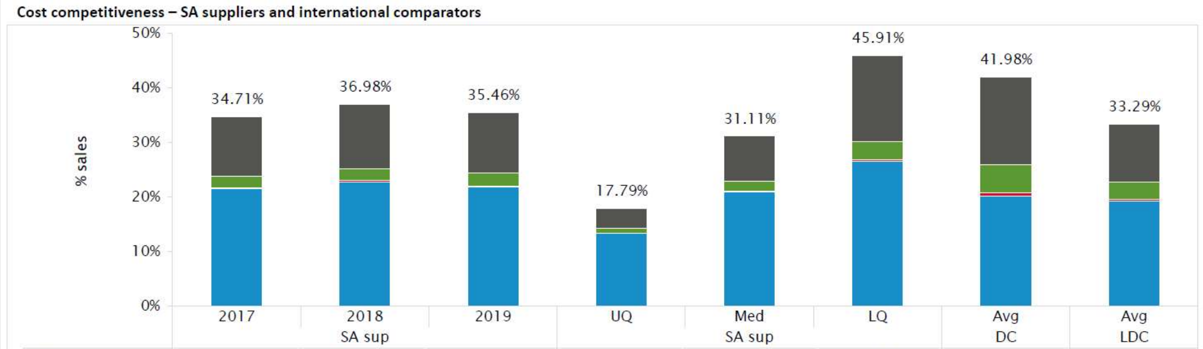
Manufacturers of big/structural body parts are not necessarily concerned with trade protection because it will not be viable for OEMs to import these parts. At the beginning of a car model project, the OEM would consider all the locations where parts are made and develop the best fit from all locations to get the best price and quality (Industry expert E).

Investment barriers

Industry expert A explains that being in the body manufacturing industry is very costly due to the high cost of tooling necessary for very high-quality standards required. South Africa has no tooling capability, and tools for body manufacturing need to be imported.

Availability and cost of utilities

It can be seen in Figure 5-6 that the average cost of electricity and water costs for South African suppliers competes with the average of developing countries (Avg DC) and less developed countries (LDC), although the competitive advantage in terms of electricity and water costs are much smaller when compared to LDC. Electricity costs increased year on year from 2017 to 2019 from 2,08% to 2,37% as a percentage of sales, and a growing concern is the availability of electricity due to the incapacity of Eskom to supply the electricity demanded by the country and electricity demand management by using load-shedding. It is important to note, regarding Figure 5-6, that the costs are calculated according to the percentage of sales and that the upper quartile suppliers' relative costs could be lower due to higher-value components supplied. However, it can also be that more optimal electricity and water-saving processes have been implemented.



	2017	2018	2019	UQ	Med	LQ	Avg DC	Avg LDC
Waste costs	10.95%	11.94%	11.16%	3.67%	8.22%	15.84%	16.03%	10.63%
Electricity costs	2.08%	2.12%	2.37%	0.87%	1.90%	3.33%	5.25%	3.23%
Water costs	0.27%	0.22%	0.16%	0.03%	0.08%	0.19%	0.54%	0.28%
Employment costs	21.40%	22.70%	21.77%	13.22%	20.91%	26.55%	20.16%	19.15%
Total	34.71%	36.98%	35.46%	17.79%	31.11%	45.91%	41.98%	33.29%

Figure 5-7 Competitiveness of South African suppliers and international suppliers (B&M Analysts, 2020)

Skills and managerial skills availability

The skills levels needed for highly automated machinery cannot be found in South Africa, and South African employees with potential will be sent to head office for training or to company plants in another country depending on what skills are needed, explains industry expert C. He adds that expats come to South Africa to work on more specialised projects or to train workers on the tools or equipment. According to industry expert F, the skills needed can be found, but it is very scarce, which directly limits their flexibility in terms of having standby employees or choice concerning with whom they work. The AIDC has an incubation centre for business owners, but business owners need experience in factories to understand the business and other skills needed are team leaders, tool maintenance and quality assurance (industry expert F). Industry expert B is in comments that proper training is not available in South Africa.

Political risk or instability

When asked what factors are considered when business developments in South Africa are considered, political risk or instability was somewhat important to industry experts C and E, but industry expert F commented that it is a significant concern. Industry expert E added that policy uncertainty is an influential factor when considering new projects in South Africa, the uncertainty which came with the time it took the government to launch the SAAM and revised APDP concerned the supplier and their partnered OEMs.

Infrastructure

Regarding infrastructure, the most significant concern is the power supply, which has been discussed under the availability and cost of utilities. Another concern is the transportation infrastructure for acquiring raw materials (industry expert F). Telecommunication infrastructure is essential, mentioned industry expert E, as company supporting services are accessed globally using the internet and telecommunications.

Nearness and quality of material inputs and suppliers

Industry expert A explains that tier 3 suppliers, who supply the raw materials (e.g., steel) are usually MNCs and preferred by the OEMs, and OEMs mostly require tier 1 suppliers to use their preferred raw material suppliers because they have the quality versus cost levels preferred. Industry expert C, E and F confirms the use of preferred suppliers and prescribed specifications from OEMs for raw materials. Industry expert C comments that local raw material suppliers cannot supply to OEM specifications and also not at the price at which it is imported, because they struggle to reach economies of scale, seeing that different OEMs have different raw material specifications and raw materials can also vary from model to model. According to industry expert E, OEMs develop their preferred quality and safety requirements in terms of raw materials used, and if they source materials from suppliers other than the prescribed suppliers, the OEM will first test the materials and then approve or deny the raw material supplier. All raw materials used for structural body parts and skin are imported (industry expert E). Industry experts D and F agree that local steel can be sourced for parts that are not used in the body's main structure, although OEMs are strict in terms of quality levels. The distance of material inputs and suppliers is not seen as a problem as OEMs have trusted raw material suppliers, and raw material inputs are planned at the Request for Quote (RFQ) stage.

Nearness and quality of supporting services

Tier 1 suppliers of big body parts have their supporting services at their head offices, telecommunications and online services are used to access R&D and maintenance support services.

Institutions and trust

As mentioned in the labour cost and productivity section, industry expert C raised the concern of the power of labour unions in South Africa, which relates to the flexibility market requirement. However, there is a cost risk in terms of the labour negotiations every three years, as explained in the labour costs and productivity section. The experience with government and government interventions have been good, but a crucial part of the overall experience in South Africa commented industry expert F. The quality management of the products are highly dependent on the trust between OEMs and the first-tier suppliers, and they have long-standing global relationships.

Demand distance

Demand distance for big body part manufacturers is not a concern. As mentioned earlier, these manufacturers have to be in close proximity to their customers, ensuring the level of quality needed and enabling them to offer a reliable, responsive and flexible service. Due to the proximity, transport costs are not a concern for these suppliers.

Government policies and regulation, including taxes and incentive schemes

There is consensus that the incentives, grants and subsidy schemes implemented in the form of especially the APDP, AIS and the IDC have been an advantage to the body parts industry, specifically, incentives for automotive tooling (Industry expert B, E and F). According to industry expert B, incentive schemes that link to government policy and regulation have been the most beneficial location factor. The overarching factor for the success of the automotive incentives and policies is the positive feedback regarding the commendable relationship with government institutions. Regarding taxes, there was positive feedback regarding SEZs, but when compared to factors such as supplier development and relationships with OEMs, it is not regarded as significant.

Table 5-7 Summary of location success factors impacting performance dimensions

		MARKET REQUIREMENT DEFINITION				
		Cost 40%	Quality 20%	Reliability 20%	Flexibility 10%	Product Development 10%
Location success factors	Labour costs and productivity	• Low productivity levels in SA • Wage negotiations every 3 years • Labour with required skills and experience are very expensive			• Wage negotiations every 3 years • Labour with required skills and experience are very expensive	
	Exchange rates	• Exchange rate fluctuations				
	Trade Protection	• Importing large body parts not viable				
	Investment barriers	• Cost of tooling is very high	• Tooling needed for quality required by OEMs			
	Availability and cost of utilities	• Eskom load-shiedding • South African costs in line with other less developed countries		• Eskom load-shiedding	• Eskom load-shiedding	
	Skills and Managerial skills available	• Required skills scarce • Lacking sufficient experience	• Required skills scarce • Lacking sufficient experience		• No standby employees and cannot choose who to work with	
	Political instability (Corruption)	• Significant concern • Government decision-making process lengthy			• Government decision-making process lengthy	
	Infrastructure	• Transportation infrastructure • Telecommunication infrstructure		• Transportation infrastructure • Telecommunication infrstructure		
	Nearness and quality of material inputs and suppliers	• OEMs import raw material from preferred suppliers • Raw material at required quality is expensive in SA	• Raw material at required quality is expensive in SA	• Raw material at required quality is expensive in SA	• Raw material at required quality is expensive in SA	
	Nearness and quality of supporting services	• Supporting services at head office				
	Institutions and trust	• Power of labour unions • Experience with government have been good		• Trust between OEM and government	• Power of labour unions	
	Demand distance/Transport costs	• Body part suppliers need to be in close proximity to OEMs				
	Government policy and regulation, taxes and	• Incentive schemes				

In this section, location factors that influence firms' ability to manufacture body parts and their effect on the market requirements were discussed. Some of these location factors are deemed more significant regarding the moderating factors discussed in the next section.

5.4.2. Moderating Factors

Bam, De Bruyne and Schutte (2020) defined moderating factors which highlight the importance of certain location factors related to an activity's specific industry and firm. Industry or product-related moderating factors (discussed in Section 5.4.2.1.) and the firm related moderating factors (discussed in Section 5.4.2.2.) and their impact on the body parts industry and firm are considered in this section. The moderating factors are summarised in Section 5.4.2.3.

5.4.2.1. Industry-related moderating factors

Firstly, the industry-related moderating factors were discussed, including the complexity of production and technology intensiveness, the dynamism of the product market environment, maturity of products, economies of scale, and product testability. These factors are discussed below.

The complexity of production and technology intensiveness

The complexity of production processes and the technology intensiveness were considered under the theme of automation. This moderating factor is an indication of the skills level needed and the availability for these skills in the industry. Participants were asked to comment on the current level of automation, the predicted automation for the next three years and why automation is a priority or not. To which they responded the following:

> A: The industry is not at a point where total automation is necessary. Automation is costly, but body part suppliers will mostly only automate if it is a requirement from OEMs.

> C: The automation of the manufacturing and assembly processes depend on the capital outlay of the OEM, the higher the capital outlay, the greater the levels of automation, thus more expensive equipment and processes can be afforded. Certain OEMs have high investments in laser equipment to achieve the desired quality. For OEMs with smaller capital outlay, the automation processes would be less, but due to quality requirements, the levels of automation used are still relatively high. Minimum labour is needed, but the skills needed for operating the equipment is highly specialised.

> E: Processes are highly automated; tools pick up parts as parts are scorching due to hot forming techniques used (700°C). The company has internal tool building capabilities and the skills needed are highly sophisticated, able employees are sent to the company's head office to get training for tool maintenance in South Africa.

> F: Processes are mostly automated, but automation investment is driven by OEMs to comply with quality requirements. If OEMs do not drive automation, a cost-benefit study will first be done before an investment is made. Other automation investment will be made for safety purposes. More technical skills are needed for manning the tool and die.

In conclusion, the industry is mostly automated; further automation is mainly dependent on the OEMs' stringent quality requirements, and further automation investment will be made at the request of OEMs. There is consensus among the industry experts that the skills levels needed for the tools and machinery used in the body parts industry are very sophisticated and cannot be found in South Africa. If the required skills are found in South Africa, it is very costly. Due to the complexity of production processes and the technological intensiveness, skills levels, skills availability and cost of skills were identified as focus areas in terms of location factors.

The dynamism of the product market environment

The dynamism of the product market indicates the need for **supporting services at a location**, in other words, in a more dynamic market, there is a need for firms to be able to increase manufacturing volumes with short notice or be able to develop improved products quicker than in a less dynamic market. Therefore, there is a greater need for supporting services, such as raw material availability, in order to be able to supply a more dynamic market.

In terms of the automotive body parts industry, car model projects are fixed for seven years with a possible facelift after three years (industry expert C, E and F); therefore, the volumes and requirements for a model will be stated at RFQ stage. The suppliers for all parts in a passenger vehicle are determined at the RFQ stage.

Seeing that the market for the body parts is not dynamic because body part manufacturers have time to plan for volumes, it is assumed that location factors such as local availability of raw materials and support services are less influential in terms of location factors.

Knowledge spillovers

How easily knowledge is spilled over in the industry determines the influence of supporting services, competitors (Bam, De Bruyne and Schutte, 2020) and the level of cross-industry value chains (Deloitte, 2018) at a location. The proximity to OEMs is also a key location factor for the automotive industry (Barnes and Kaplinsky, 2000b; Bennett and Klug, 2012; Naude, 2013; Schmitt and Van Biesebroeck, 2013). As mentioned in Section 5.3.1.3, the body parts manufacturing industry is highly sophisticated and to reach the quality levels required by OEMs, it is difficult to copy and paste the processes. It is therefore assumed that knowledge is not easily transferred in the automotive body parts industry.

Participants were given a list of location factors important for knowledge spillovers; this list included proximity to OEMs, cross-industry value chains, industrial parks, SEZs, clusters, proximity to competitors, proximity to OEM R&D and systems integration with OEMs. The results are given in Table 5-8 below.

Table 5-8 Factors necessary for knowledge spillovers

Industry expert	**Knowledge Spillover factors important for the industry**
B	Proximity to OEM
C	Proximity to competitors
E	Relationship with OEMs and systems integration
F	Proximity to OEM (Supplier/employee training at OEM)

Industry experts B and F agree that proximity to OEMs is essential for knowledge spillovers, but competitors, systems integration and employee training also plays a role. As knowledge is not easily transferred in the industry and considering the emphasis on OEM relationships and proximity, institutions and trust and demand distance were identified as essential location factors.

Maturity of products

The maturity of products determines a firm's needs, where firms of mature products are more focused on economies of scale and reducing manufacturing costs versus science development for entry-level products. As mentioned in Section 5.2.1, body parts are mature products developed by mature firms. Therefore, it is assumed that optimal manufacturing costs are a priority, and the costs of utilities and labour and productivity are regarded as influential location factors.

Economies of scale

As the body part industry is a mature industry, economies of scale become increasingly essential to benefit from manufacturing cost savings. When economies of scale can be reached at a particular location, it might not benefit the parent company to locate another plant in the same region because the demand might not be high enough to reach economies of scale at both locations. It might be more beneficial to improve the existing plant to also deliver to other nearby regions. The same can be said for a plant without economies of scale; locating another plant close to the existing location will not make a viable business case. Participants were asked to comment if economies of scale are needed to make manufacturing viable and if economies of scale can be reached in South Africa:

> A: To reach economies of scale is difficult because different OEMs have different requirements regarding quality and specifications for each specific car model.
>
> C: In terms of model projects, different OEMs will give numbers of vehicles per model at the RFQ stage, and the project plan will then be adjusted accordingly. If volumes are low, more manual labour will be used as far as possible in order to reduce cost. If volumes are high, more automation will be used as costs will be covered by the number of parts produced; usually, these are the OEMs with more stringent quality requirements. Regarding raw materials, raw material mills struggle to reach economies of scale as different OEMs have different specifications for steel and steel requirements can also vary for different models.
>
> E: Economies of scale not possible due to small production runs of models. There are high volume OEMs and low volume OEMs, and the cost of the tool has to support the business case. Therefore, some OEMs' quantities are too low for viable production. In the case where OEMs with low volume, high-value cars require the quality of sophisticated tooling, they will absorb the cost of production inefficiencies. Critical mass is critical to absorb the cost of the tools and ultimately ensure the viability of the project.
>
> F: Demand in South Africa is low, and economies of scale cannot be reached. The difference between South African markets and other global markets are higher domestic volumes, which translates to higher returns to scale (Industry expert F).

Most industry experts agree that economies of scale cannot be reached for bigger automotive body parts. Therefore, it can be assumed that it would not make sense for more manufacturers of sizable automotive body parts to locate in South Africa because volumes demanded are too low. From discussions with the industry experts, the market for body parts and, indirectly, the market for passenger vehicles are more influential location factors in terms of economies of scale.

Testability of product

The testability of a product is an indication of the quality management support and confidence needed in suppliers. Quality requirements are communicated to body part manufacturers at the RFQ stage (industry expert C) regarding quality materials used and body parts required. Body part manufacturers are also required to automate certain processes in order to ensure specific quality standards. Generally, the conformance of products to these quality standards are relatively easy to test before assembly. Also, OEMs have preferred suppliers for components and suppliers who are trusted to deliver to the required quality standards. Industry expert C also contributes quality assurance to the proximity to OEMs. Therefore, the product's testability impacts trust and institutions and demand distance location factors.

5.4.2.2. Firm related moderating factors

The moderating factors important to the firm of the body parts industry are discussed in this section. These factors include the existing global footprint, experience at different regions, the interdependence between different functions of the firm, the life cycle stage of the firm, and the firm's size.

Existing global footprint

A firm's existing global footprint could influence location decision making when regarding experience at existing locations. The success of certain location factors experienced at a location could be required from prospective new locations. Body part manufacturers are globally integrated, and their global footprint depends on the location of the OEMs they supply because of the importance of proximity to the industry, as discussed with industry experts:

> E: The fact that all cars belonging to an OEM across the globe are precisely the same regarding the quality of components and raw materials used, is a competitive strategy of certain OEMs. Plants are situated where their customers (OEMs) are due to transport inefficiencies and the nature of certain parts. The skin, which is the shiny, painted outer side, damages quickly; therefore, proximity to OEMs ensure minimum transport is important.
>
> F: Proximity to OEM is more economical in terms of transport of bigger body parts; therefore, plants are based close to their clients.

Therefore, it is assumed that the existing global footprint depends on the demand distance, but more importantly, if there is no viable business case for the customers of body parts (OEMs) in South Africa, there will also not be a viable business case for body part manufacturers in the country.

Experience in different regions

Determining what location factors contribute to a good experience in different regions can indicate what location factors are essential for a firm. Participants were asked what factors contributed to a good experience in different regions in South Africa:

> A: Ease of access to raw materials, for example, in the Eastern Cape. Also, the availability of land in the Eastern Cape.
>
> B: Proximity to ports are essential for imports of raw materials, furthermore the proximity to OEMs.
>
> C: South Africa is regarded as safer than other African countries; thus, South Africa is in a unique location to access African markets.

Location-specific factors regarding experience in different firms are access to ports and safer working environments; therefore, transport infrastructure is an important location factor. Also, political stability, as an indirect effect on safety in a country. The experience in terms of the country's ports are good, but it is essential to sustain the transport infrastructure and ensure it is world-class.

Interdependence between different functions of the firm

If a manufacturing plant depends on another plant for inputs in the same proximity, then other location factors are not as important, as proximity between interdependent firms will most probably trump other location factors. Participants were asked about the interdependence of their plant on other plants to deliver a body part to an OEM:

> C: The global head offices of the OEMs will decide on the shape of a new car model, which will then be communicated to the body part manufacturers in the country where the OEM is situated for a request for quote (RFQ).
>
> E: The company has a centre of excellence where plants across the globe can tap into for information regarding operating the tools and maintenance. The company uses 4D glasses to support maintenance in SA if the skill is not available; thus, technology for communication is essential.
>
> F: R&D is a head office function. There is consensus that R&D is the only function for which the plants in South Africa are dependent, and also in cases where the skills for tool maintenance cannot be acquired, an online centre of excellence can be accessed. Body part manufacturers are also dependent on raw material imports, but this can be planned during the start of a model project.

Therefore, there is no interdependence between different body part manufacturers' plants to deliver a final product, and the only location factor associated with R&D communication is the telecommunications infrastructure.

Life cycle stage of the firm

Different life cycle stages relate to different firm requirements, where developing firms are more innovative and might need more investment versus developed firms with a built-up reputation and regular customers. As mentioned in Section 5.2.1, the firms in the body part manufacturing industry are mature and globally integrated (5.4.2.7) and are not dependent on the local component and raw material suppliers as they have global partners. They also have standing relationships with OEMs, supplying to the same OEMs globally; therefore, institutions and trust are considered influential in the body part industry.

Size of the firm

The firm's size determines its influence over its suppliers, the smaller a firm, the more critical proximity to suppliers becomes. The multi-national body part manufacturers are not dependent on the local suppliers for inputs; therefore, the proximity to local suppliers play a minor role. These firms also have the capital to invest in tooling required by OEMs. Again, large firms have been in the industry for longer with long-standing relationships; thus, the institutions and trust factor are reiterated.

5.4.2.3. Summary: Moderating factors

The moderating factors for large body part firms and industry were discussed; these factors highlight location factors that are important to the body part industry and firm. A summary of the factors can be seen in Figure 5-9.

The location factors which were highlighted specific to the industry are:

- skills levels, skills availability and cost of skills,
- demand distance,
- institutions and trust,
- cost and availability of utilities,
- labour cost and availability,

- size of the market for passenger vehicles.

The location factors highlighted specific to the firm are:

- demand distance,
- viable business case for OEMs in South Africa,
- transport infrastructure,
- political stability,
- telecommunications infrastructure,
- institutions and trust.

The location-related dynamics will be discussed in the next section.

	Moderating factors for large/structural body parts			
	Moderating factors	**Automotive body industry**	**Impacted**	**Specific location factors**
Industry/ product related	**Complexity of production processes**	•High	• Skills levels needed are highly sophisticated • Automation is driven by OEMs, therefore skills needed could increase in the near future • Highly skilled individuals in South Africa are expensive	•Skills level •Skills availability •Cost of skills
	Dynamism of product market environment	•7-year projects/3-year facelift projects	•Projects planned at RFQ stage	• No specific location factors highlighted
	How easy is knowledge spillover	•Easy in terms of OEM model projects •Difficult in terms of skills	•Proximity to OEM is important/Systems integration • Support in terms of specific skills needed (robotics, technical, etc.)	•Demand distance •Skills development
	Maturity of products	•Mature product	•Optimal manufacturing costs are of high priority	•Cost and availability of utilities •Labour cost and availability
	Economies of scale	•Not possible for bigger body parts due to cost of tooling and low demand	• Cost of production inefficiencies are absorbed by OEMs •For body parts suppliers competition is stiff, new players in the field will not have enough volume for viable business	•The size of the market for passenger vehicles
	Testability of product	•Easy •Bigger body part suppliers are close to OEMs in terms of location	•Quality management easier •Proximity ensure optimal quality management •High trust levels between OEMs and tier 1 suppliers - usually they are global partners	•Trust and institutions •Demand distance
Firm related	**Existing global footprint**	•Globally integrated •Located where there is OEM demand	•Body suppliers are reliant on OEMs for demand •Proximity is important in terms of the nature of the product as it damages easily and optimal shipping is not possible •If there is not a viable business case for OEMs in SA, there will also not be a viable business case for bigger body parts in SA	•Demand distance •Viable business case for OEMs in South Africa
	Experience in different regions	•Proximity to ports and OEMs are key •Saftey regarding Africa	•Sustained infrastructure needed •Safe working environments	•Transport infrastructure (ports) •Political stability
	Interdependence between different functions of the firm	•No interdependence in terms of delivering the actual product •MNCs make use of technology to support plants in different locations	•Communication infrastructure is important •Plants are dependant on parent companies for R&D projects	•Telecommunications infrastructure
	Life cycle stage of the firm	Mature industry	•Long term and established relationships between OEMs and tier 1 suppliers	•Institutions and trust
	Size of firm	•Multinational firms for bigger automotive body parts (majority)	•Raw materials or smaller parts can be imported from trusted suppliers across the globe	•Institutions and trust
	Technology intensiveness	•Same as complexity of production processes	•Same as complexity of production processes	•Same as complexity of production

Figure 5-8 Moderating factors for the body part industry

5.4.3. Location-related dynamics

When the viability of business developments or projects in different countries is considered, the static location determinants are measured for the different locations, but these factors need to be considered for the full duration of a new business venture; therefore, there is a need to understand the expected performance of a country. Therefore, as Bam, De Bruyne and Schutte (2020) defined, the location-related dynamics will now be discussed. The location success factors which could affect the performance dimensions are listed in Table 5-10, and the possible impact on anticipated cost, quality, reliability, responsiveness, lead time, product development, environmental performance and sustainability can be seen. These location success factors and the possible impact on the anticipated performance dimensions will now be discussed.

In order to understand the effects of exchange rate volatility, the threat of expropriation, political risk or instability, regulation, bureaucratic risk, economic stability and risk of strikes, the participants in the survey were asked to comment on possible factors which are considered when future business developments in South Africa are planned (Results can be seen in Table 5-9).

Table 5-9 Industry replies regarding business decisions

	Industry Expert		
	C	E	F
Exchange rate volatility	→	→	↓
Threat of expropriation	→	→	
Political risk or instability	→	→	↓
Regulation	→	→	
Bureauctratic risk	→	→	
Economic stability	→	→	↓
Risk of strikes	↓	→	↓

Key	
→	Moderate risk
↓	High risk

Regarding **exchange rate volatility**, industry expert E commented that it is not a concern for their customers (OEMs) because the OEMs import raw materials and export finished vehicles; thus, a natural exchange rate hedge occurs for OEMs. In terms of their own business, industry expert C explained that a specific cost for tooling is projected when budgeting for a new project and exchange rate volatility could negatively affect their profits. Industry expert F also considers the exchange rate a risk when projecting for tooling. The **threat of expropriation** is considered but not seen as a possible issue in the near future by industry experts C and E. **Political risk and instability** are considered moderate by industry expert C and E because of the government's standing relationship and incentive schemes' success. Industry expert F regards policy uncertainty as a high-risk factor. Industry experts C and E regarded the possible impacts concerning governmental **regulation and bureaucratic risk** as moderate.

Regarding **economic stability**, it can be seen in Table 5-9 that industry experts C and E consider changes in economic stability as having a moderate effect on the body parts industry. However, industry expert F regards economic stability as having a significant effect on the industry, car model projects run up to seven years, and economic stability can have a considerable impact on a project in seven years in terms of viability. However, during seven years, the impact of economic volatility could average out.

The **risk of strikes** is a concern for all the industry experts C and F and could cause **supply chain interruptions** and **impact logistical chaos risk.** All of these factors will have a considerable effect on anticipated cost and reliability, and flexibility. Industry expert E commented that after a six-week automotive strike and a fourweek component strike, their customer (OEM) moved the production of 100 cars a day from their South African plant to a European plant.

Other dynamic success factors that were discussed, derived from other questions or obtained from desktop research, are congestion effects from growth in the industry, legal risk, capacity changing and switching costs, process risk, learning curve effects, and quality of information available, will now be discussed.

Congestion effects from growth in the industry are not considered a possible problem because of the high investment barriers and the fact that competition in the industry would not reach returns of scale. **Legal risk** is a concern, especially for MNCs as different countries and markets have different regulations and managing these changes can pose a risk; these types of risks are managed by enterprise risk management (PWC, 2018). It is assumed that this should not be concerned as high risk due to the commendable relationships automotive stakeholders have with the government. Due to the car model projects running for seven years with possible changes every three years, there are no likely risks regarding **capacity changing and switching costs** as labour requirements, material inputs and the required skills are planned at the start of the project. The body part manufacturers are multi-national manufacturers with global standard processes to deliver quality products on time; the fact that the market for body parts is not very dynamic also ensures low **process risk**. Regarding the **quality of information available**, there was uncertainty regarding revisions of automotive policies, but regarding the relationship with the government and automotive institutions, information gaps were overcome.

Learning curve effects can be influenced by social network development, local skills development, supplier development and labour efficiency increases. The importance of the relationships between OEMs and government and OEMs and tier 1 suppliers are reiterated, but there could be learning effects associated with developing the relationship between South African based suppliers. The ease of knowledge spillovers moderate the importance of skills development and supplier development, and as emphasised in Section 5.2.2, knowledge spillovers are challenging in the body parts industry. Skills and supplier development would have learning curve effects for the automotive industry as a whole. Seeing that body parts are mature products, manufacturing costs become increasingly significant, and labour efficiency increases would have an improved effect on manufacturing costs and improving the business case for manufacturing in South Africa.

Performance improvement from the growth of the industry or related industries at a location can be influenced by improved factor supply and improved social structures and institutions that promote knowledge sharing. If raw material suppliers are supported regarding R&D projects, overcoming investment barriers and industry knowledge and training, there is the possibility that body part manufacturers would be able to source from local suppliers. The upliftment of the raw material industries, which could supply the body part industry, will be positive regarding all the performance dimensions.

Table 5-10 Summary of location-related dynamics impacting the anticipated performance of performance dimensions

		Anticipated cost (incl. uncertainty & risk premium)	Anticipated quality	Anticipated reliability	Anticipated flexibility	Product Development	Anticipated environmental performance	Sustainability (social performance)
Location success factors	Exchange rate volatility	• Tooling cost • Natural hedge for OEMs						
	Learning curve effects	• Relationships: OEMs and government and OEMs and Tier one suppliers • Relationships between SA based suppliers • Skills and supplier development for knowledge spillovers • Labour efficiency increases			• Skills and supplier development to increase skill supply			
	Political risk or instability	• Relationship between OEM and government						• Incentive schemes
	Economic stability (incl. inflation)	• Demand for vehicles impact on market for body parts						• Demand for vehicles impact on market for body parts
	Risk of strikes/Logistical chaos risk/Risk of su	• Strikes are greatest concern		• Strikes are greatest concern	• Strikes are greatest concern			
	Performance improvement from growth of industry/related industries at location	• Support toward raw material suppliers	• Support toward raw material suppliers	• Support toward raw material suppliers	• Support toward raw material suppliers	• Support toward raw material suppliers	• Support toward raw material suppliers	• Support toward raw material suppliers

The dynamic location success factors were discussed in this section: exchange rate volatility, learning curve effects, political risk or instability, economic stability, risk of strikes, risk of supply chain interruption, performance improvement from growth in the industry risk, and logistical chaos risks were discussed. This phase will be concluded in the next section.

5.4.4. Concluding phase 2

In the second phase of the LDEF, the location success factors, moderating factors and the dynamic location success factors were defined. The **location success factors** were discussed using interviewees' feedback and desktop research and considered according to the market requirement dimensions; these included, among others, labour costs and productivity, exchange rates, availability and cost of utilities and demand distance. The **moderating factors** were defined, and location factors important specifically to the body part industry and firm were defined. Moderating factors for the firm included. Finally, the **dynamic location factors** were defined with their anticipated effect on performance dimensions. The dynamic location factors include, among others, exchange rate volatility, risk of strikes, economic stability and threat of expropriation. The following section, phase 3, covered the interaction moderator dynamics. A summary of the location success factors can be seen in Figure 5-9. In Figure 5-9, only the static and dynamic location success factors with an effect on cost were included because all the success factors affect the cost market requirement, and the cost requirement carries the most weight.

Static location success factors		Dynamic location success factors	Moderating factors
Cost		Anticipated Cost	**Industry-related**
40%		40%	Skills, availability and cost
• Labour with required skills and experience are very expensive • Wage negotiations every 3 years • Employees lack sufficient experience and skills • Transportation infrastructure • Low productivity levels in SA • Government decision-making process lengthy • Raw material at required quality is expensive in SA	• Cost of tooling is very high • Eskom load-shiedding • Power of labour unions • Political stability (corruption) a significant concern • Incentive schemes • Telecommunication infrastructure • Experience with government have been good • Transport infrastructure	• Relationships: OEMs and government and OEMs and Tier 1 suppliers • Developing relationships between SA based suppliers • Strikes are a risk • Tooling cost • Skills and supplier development for knowledge spillovers • Labour efficiency increases • Support for raw material suppliers	Institutions and trust Cost and availability of utilities Labour cost and availability Passenger vehilce market Demand distance **Firm-related** Demand distance Viable business case for OEMs in SA Transport/telecommunications infrastructure Political stability Institutions and trust

Figure 5-9 Summary of location analysis

5.5. Phase 3: Interaction moderator dynamics

5.5 Phase 3: Interaction moderator dynamics	
5.5.1 Interaction moderator factors	**5.5.2** Concluding phase 3

The market for body parts and the location success factors have been discussed, but to understand the "effective performance" (Bam, De Bruyne and Schutte, 2020), South Africa can offer the interaction between the market-related dynamics and location-related dynamics will now be discussed (Section 5.5.1). This phase is concluded with a summary in Section 5.5.2.)

5.5.1. Interaction moderator dynamics

The interaction moderator dynamics interprets the dynamic factors between the market and location, which should also be considered when planning for development at a specific location; these factors, as suggested by Bam, De Bruyne and Schutte (2020), were considered and can be seen in Figure 5-8.

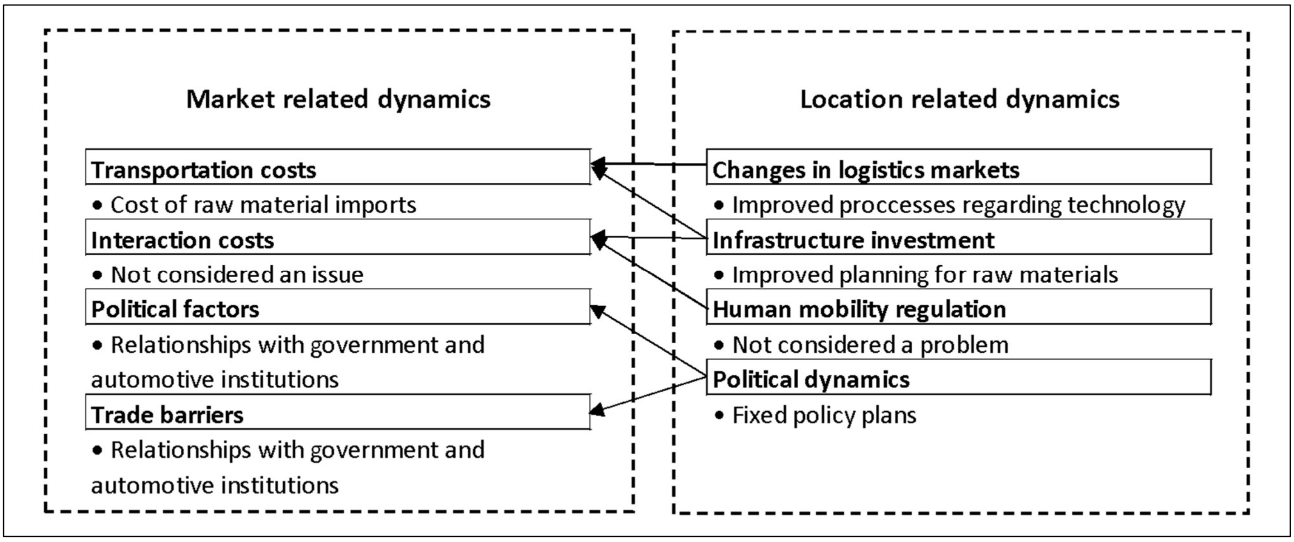


Figure 5-10 Interaction moderator dynamics

Regarding **changes in logistics markets**, global trends are increasingly improving logistics regarding technology developments, although, for the body parts manufacturing industry, the transport cost of importing raw materials is the most significant concern. Also, relating to the import of raw materials and

improvement of transport infrastructure, specifically port management and physical port improvements, could aid the body part manufacturers in planning for raw material deliveries and managing stock keeping for when ports are full, or weather does not permit docking. The **cost of interaction** is not considered a problem at this stage because body part manufacturers are close to their customers, and human mobility regulation is not of concern in South Africa. Concerning **political dynamics and political factors**, the body part manufacturers are confident in their relationships with government and automotive institutions and the incentive schemes offered by South Africa. The SAAM was developed with industry stakeholders in industry engagement sessions to ensure an "industry-led automotive" vision (Black *et al.*, 2018). **Trade barriers** are not a concern when regarding the relationship between OEMs and government and automotive institutions. Finally, **human mobility regulation** is not seen as a current or future risk for doing business in South Africa.

5.5.2. Concluding phase 3

Phase three consisted of defining **dynamic interaction factors** that could affect the location and market factors over time. These factors are discussed in terms of the interaction between transportation costs, interaction costs, political factors and trade barriers and changes in logistics markets, infrastructure investment, human mobility regulation and political dynamics. In summary, the most important interaction moderator factors are:

- Changes in logistics markets in the form of improved technology;
- Infrastructure investments;
- Relationships with government and automotive institutions; and
- Fixed policy plans in the form of incentive schemes.

Finally, possible policy implications are discussed in the next section.

5.6. Policy implications

Finally, the output from the location factors can be considered, and possible policy implications suggested. In doing so, there is a need to emphasise four factors that were a concurrent theme during the analysis:

- The body parts manufacturing industry relies on demand from OEMs which is indirectly connected to the volume of passenger vehicles demanded.
- Regarding policies, OEMs and first-tier suppliers are enticed by AGOA, SA-EU FTA and the APDP to make up for low domestic volumes.
- The OEM and first-tier relationships are global relationships, and if a business case does not exist in South Africa for the seven OEMs, the chances are that OEMs and first-tier suppliers will relocate as a partnership to another location.
- The relationship between the automotive industry and government and automotive institutions is another theme that is considered critical for the success of the automotive industry in South Africa.

The static and dynamic location factors from the market, location, and interaction analyses were considered and sorted using a SWOT analysis (Figure 5-12) to understand the policy implications from the LDEF better. These factors, sorted according to the SWOT analysis, will now be discussed, excluding the factors mentioned above.

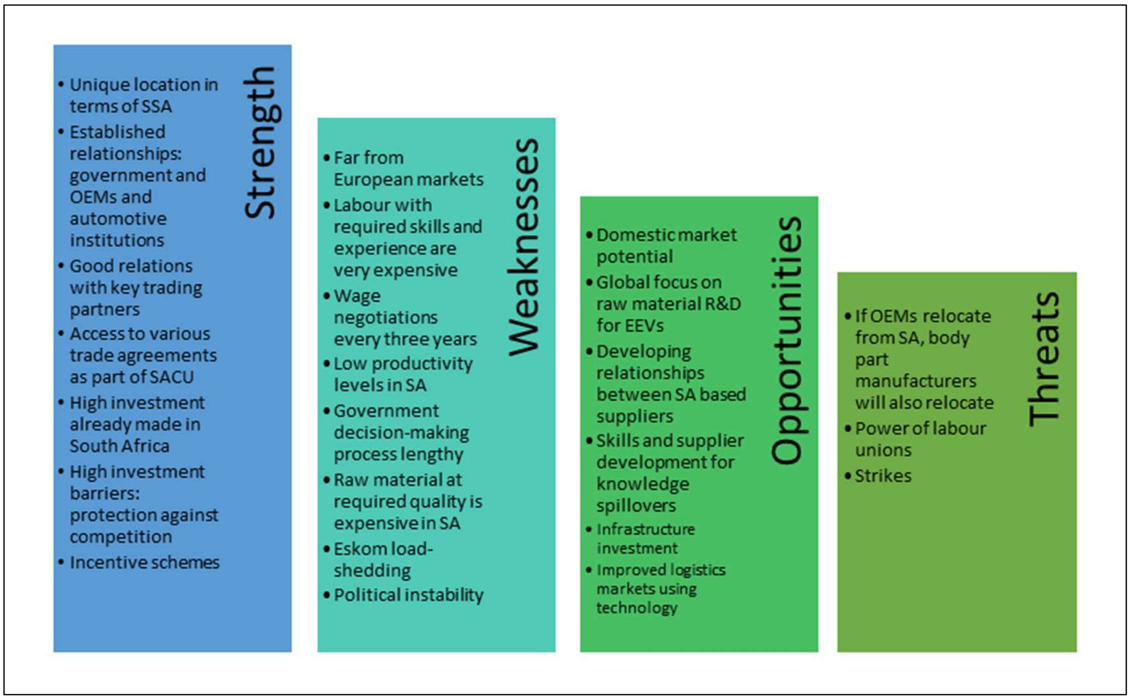


Figure 5-11 SWOT analysis from the output of LDEF

Firstly, South Africa, as a location for manufacturing body parts, owns certain location factors, which counts in the country's favour and should be sustained to ensure a viable business case for automotive stakeholders. These include the unique geographical location of South Africa in terms of access to SSA, good relations with key trading partners and high investments already made in the country by OEMs and body part manufacturers.

There are certain drawbacks when doing business in South Africa. Government and automotive institutions should focus on improving these to make South Africa a more enticing location. The location factors which need attention are the decision-making process when the government changes incentive schemes, load-shedding and political instability. Other location factors which need attention:

- There is a need for technical skills at affordable wages in South Africa. The global industry is moving towards automation for quality purposes, therefore an ever-increasing need for technical skills. There is a need to understand OEMs' technological roadmaps and skills development plans to align the South African automotive workforce. Currently, there are business owner development initiatives implemented by the government, but these initiatives lack industry specific experience.
- Labour costs and productivity are a concern in South Africa, especially wage agreements during car model projects, which could negatively affect these projects' profitability.

Specific opportunities were highlighted when the location factors for the body part industry were considered. These opportunities include developing relationships between SA based suppliers and skills and supplier development for knowledge spillovers in the industry. South Africa is far from its main trading partners, but in order to improve doing business in the country, there should be a focus on infrastructure investment and improved logistics markets with the use of technology. In terms of raw materials and environmental regulations, the following opportunities exist:

- The investment barriers for raw material manufacturers are high regarding product development, and their expertise is too limited to develop the raw materials consistent with OEMs' quality and cost requirements. There exists an opportunity for raw material manufacturers because, currently, most raw materials are imported. More importantly, due to the global move towards more fuel-efficient and environmentally-friendly vehicles, a unique business opportunity exists for body part raw materials.
- The emphasis of OEMs to ensure global consistency of quality of vehicles creates an opportunity for raw material manufacturers. If they can achieve the quality and cost standards required by local OEMs, they will also be able to supply OEMs in other countries.
- A head start on environmental R&D projects could be a way to lure further investment into the local automotive industry, especially European markets, which has some of the most stringent environmental regulations in the world.

Finally, there are location factors specific to South Africa, which could be a possible threat to the viability of manufacturing body parts in South Africa. Firstly, the power of labour unions is a concern for future employment negotiations. Secondly, the risk of strikes is another significant concern as this causes supply chain interruptions and logistics chaos. Also, if OEMs cannot reach manufacturing targets in South Africa due to strikes, manufacturing is moved to other countries, which decreases local demand for body parts.

The possible policy implications and the location factors, which are strengths, weaknesses, opportunities and threats for the body parts industry, were discussed. It is now possible to evaluate the frameworks for decision support tools when making policies, as discussed in the following section.

Chapter 6

6 Discussion of frameworks

As mentioned in Section 1.2.2, this study aimed to show how the IO-PS framework and LDEF can be used to support policy decision-making. The frameworks were applied as suggested by the literature, and it is now possible to conclude the effectiveness of the frameworks to support decision-making. The IO-PS will be discussed in Section 6.1., the LDEF will be discussed in 6.2, and finally, the use of both the frameworks in conjunction will be discussed in Section 6.3.

6.1 IO-PS framework

Applying the IO-PS aims to direct policymakers towards activities/products that promise possible structural and economic growth. The IO-PS was applied to the South African automotive industry and made the following contribution to policy decision making:

- From an extensive value chain of 130 activities, the IO-PS framework highlighted which activities are possible development opportunities.
- The IO-PS assigned a complexity value, opportunity gain and distance value to each activity, which enabled easier decision making when choosing an activity for further development. Each activity could be considered for its complexity value, which indicates potential structural growth and higher income levels, opportunity gain, which indicates new product and complexity possibilities for a country when an RCA for the product is achieved, and finally distance, which defines how difficult it might be expected to be to achieve an RCA for the product.
- Using opportunity gain as a variable in the IO-PS enables the study of other activities, which are defined in the value chain studied and other products in the product space, which could have high complexity possibilities. Thus, the opportunity gain considers other products (with an RCA<1) in the product space and is not confined to the value chain.
- By graphically studying the data, it was possible to choose one activity that could be expected to improve the country's structural growth.
- The activity which promised the most remarkable structural growth in terms of complexity and opportunity value with relative low distance was not used because the code was used as a blanket for everything that does not fall in the other subheadings of heading 8703. Products traded under the code (HS870390) were luxury vehicles, electric vehicles and used vehicles. A limited number of countries export these products; therefore, it makes sense from an IO-PS perspective why these products may have been deemed to have potential. For the same reason, body parts (HS870710) showed high potential because the body parts are traded in the northern hemisphere by a limited number of countries, indicating that the product could be complex.

From the IO-PS's raw output, a limitation of the framework is its inability to determine which products would not be viable for future development given existing market dynamics. For example, ICE vehicles and other products impacted by the adoption of EVs. The IO-PS framework uses the HS trade classification, which the UN Statistical Department deems as the most comprehensive system for trade statistics. This system also enabled defining an input-output structure of the industry. Trade data is also readily available for more than 5000 products defined by the HS. However, the use of the HS codes leads to the following shortcomings:

- Exporting countries need to declare what they export, and importing countries need to validate products imported with the HS Code declared by the exporting country to declare customs to be paid by the importer. However, there is room for error when declaring HS codes and also when validating the HS codes, which translates to inaccurate input data for the IO-PS.
- The WCO has officially defined all HS codes, but some countries use different descriptions; thus, they import different products on an HS code than what is stated by the WCO. Therefore, it is critical to study the actual product as defined by the WCO HS code and compare it to the HS code and the country's actual activity being studied and ensure consistency.

- There is a time lag between new products (for example, EVs) being traded and the WCO defining HS codes for the new products, which is evident in EVs being grouped in a group for miscellaneous motor vehicles (HS870390).
- There is a time lag between new definitions of HS codes by the WCO and the availability of trade data on these codes because firstly, countries need to adopt the latest codes and trade on the codes and secondly, trade data first need to be cleaned before it can be used for analysis.
- Body parts are exported to Namibia, none of the 7 OEMs based in SA is based in Namibia, so these parts could be OEM repair services based in Namibia importing OEM body parts or aftermarket repair services importing aftermarket body parts which SA imports. Thus, body parts' trade could be by body part manufacturers or aftermarket parts, making analysis of parts manufactured in South Africa difficult.
- Regarding the use of HS codes to build the I-O value chain, for tier 1 and tier 2 products, it is easy to determine if the products belong in the automotive value chain, but manufacturers supplying products on tier 3 are not necessarily only for the automotive industry. For this study, the IO-PS is comprehensive by using the input-output make and use tables, UN concord tables and BEC as suggested by the UN, but it is important to note that there might be smaller parts or raw materials used in the automotive industry, which is not included in tier level 3.

The IO-PS framework enabled choosing a product for further development, which was then an input to the LDEF, which will now be discussed.

6.2 Validation of the LDEF

The LDEF aims to systematically consider location factors that are considered necessary for manufacturing a specific product in South Africa. After application of the LDEF, it is clear that the framework makes the following contributions:

- The framework enables a thorough definition of the product under study and the methodical study of the product's market, the location factors considered necessary for a viable business case, and the interaction between location and the market.
- The framework also guides the study of the dynamic market and location success factors, considering how the market and location success factors might change over time, highlighting future development opportunities.
- The LDEF offers a framework for developing interview questions for industry stakeholders to understand how they perceive the market, location and market-location interaction.
- In applying the LDEF, it was found that the body parts industry is established and attracting other MNCs will not be a viable business case because demand is too low. However, the location success factors highlighted by the LDEF can still be used as a guide to ensure South Africa remains a viable location for body part manufacturers already based in the country.
- The framework's output suggests possible opportunities in the whole automotive industry and is not constrained to the body parts industry.
- If other activities are studied in the automotive value chain, some of the information from this study could be used as a foundation; thus, studying other automotive value chain activities will be less time-consuming.

- Using the IO-PS framework's output, the LDEF enables evaluating the product suggested by the IO-PS analysis.

The contribution of the LDEF is further confirmed by comparing the recommendations from the SAAM with the LDEF.

In order to develop the SAAM, a SAAM project was launched to complete a comprehensive study of the local and global industry. Findings and suggestions were also discussed with industry stakeholders to ensure a transparent industry and an optimally developed SAAM. Therefore, the outcomes and suggestions, as stated in the SAAM, can be used as a benchmark for comparing the output of the LDEF to understand if the suggestions and findings correlate.

The main pillars with critical recommendations to reach the vision for the automotive industry in 2035 are listed in Appendix G, with the corresponding outcomes of the LDEF. Firstly, the local economy's effect **on vehicle demand is highlighted** in the SAAM, which agrees with the location framework, suggesting the need for a healthy local economy to instil local demand for vehicles and, in return, automotive body parts. The SAAM and the LDEF underline the **importance of developing an SSA market**, seeing as South Africa is a unique location regarding access to Africa, and increased demand from SSA could improve economies of scale. The SAAM mentions the **improvement of the factor cost profile**, and according to responses from the LDEF, the most significant concern is the cost and productivity of labour and the cost and availability of electricity. The SAAM comments on having **quality core automotive materials at optimal prices available in South Africa** and developing alternative materials, responses from the framework commented that if quality raw materials are available in South Africa, it is too expensive. The availability of **semi-skilled labour and specialised management and technology skills** to increase flexibility in the industry is an outcome of the SAAM and the LDEF.

The LDEF has the following shortcomings:

- The process of defining the industry, markets and location factors is cumbersome and time-consuming.
- The activity (HS870710), as suggested by the IO-PS, comprises the assembly, sub-assembly and manufacturing of structural parts. It is essential to properly define the activity under study before applying the LDEF and ensuring that the interviewees are manufacturers of the identified activity/experts on this specific activity to save time. Smaller body part manufacturers were also considered for the study, but after finding that smaller body parts are defined under another HS code, it was removed from the study.
- As it is difficult to get hold of international stakeholders who might be considering South Africa as a location, the output of the LDEF is defined by stakeholders already based in South Africa, and certain location considerations could be missed.
- As the stakeholders have limited time available for interviews, the interview questions had to be kept as short as possible, which could lead to incomplete information.
- To ensure a focused interview questionnaire and get a thorough understanding of location decisions of the industry being studied, there is a need to do a literature study before applying the LDEF.

The application of the IO-PS framework and LDEF has been discussed, but the study aims to evaluate using both frameworks for policy decision support; therefore, using the frameworks in conjunction will now be discussed.

6.3 Using the IO-PS and LDEF together

The output of both the frameworks has been discussed separately, but this study used both frameworks to choose an opportunity for development and then assess the location factors for a viable business case for the opportunity in South Africa. Therefore, the use of the two frameworks together to support policy decision making are discussed.

Firstly, considering the IO-PS framework output after applying the LDEF, the IO-PS suggested automotive body parts as a possible economic growth opportunity. However, considering automotive body parts using the LDEF, it became evident that automotive body parts are not an optimal economic activity for exporting. The export of large body parts is not viable due to the size of body parts and the geographical location of South Africa, contributing to inefficient transportation of large body parts. Therefore, a shortcoming of the IO-PS is its inability to identify when the physical trade of a product is not possible.

The IO-PS distance variable indicates that South Africa will gain complexity and opportunity if the suggested product is manufactured in the country. However, after analysing the body parts using the LDEF, it was found that South Africa already manufactures body parts. Thus, South Africa already owns the capabilities to be able to export body parts, but the fact that body parts cannot be transported over long distances makes body parts an invalid export option for South Africa. Thus, South Africa does not have an RCA for the body parts, although it already owns the capabilities, because the IO-PS framework assumes that if a country exports a product, it owns the capabilities to manufacture the product. After applying the LDEF, it became clear that body parts are mostly traded by the northern hemisphere and developing the product for export for structural growth is not valid.

Regarding the LDEF, as mentioned earlier, it is a cumbersome framework, and considerable time is necessary to collect all information to ensure a thorough application of the framework. Therefore, it is necessary to choose a product that promises structural growth opportunities to ensure time is not wasted on products with low complexity, which would not add to economic growth and ultimately higher income levels.

Chapter 7

7 Conclusion and recommendations

This chapter aims to provide a final conclusion and recommendations. Firstly, the document summary is discussed (Section 7.1), which includes a summary of each chapter, after which the research aim is reviewed regarding the chapters used to achieve the aim (Section 7.2). Finally, recommendations for future work were suggested (Section 7.3).

7.1 Document summary

This chapter is dedicated to summarising each chapter in order to give an overview of this thesis.

Chapter 1 – Introduction

This chapter aims to provide an introduction to the study by firstly defining the background and rationale of the study. Secondly, discussing the research design includes the problem statement, research aim, objectives, and research scope. Thirdly, the rationale behind the case study selected for the research and, fourthly, the process of ethical approval was discussed. Finally, an overview of the structure of the document was provided.

Chapter 2 – Literature review

This chapter aims to give the reader a thorough background of the industry chosen for analysis to support the application of the frameworks applied in this study. Firstly, the global automotive industry was defined by defining the global automotive industry's structure, discussing global automotive production and the future of the global automotive industry. Secondly, the South African automotive industry was discussed, including the local automotive industry's current state, the industrial policies that shaped the South African automotive industry, and the automotive industry's institutional structure. Thirdly, the global automotive value chain was discussed. Finally, in the last two sections of the chapter, the background and literature regarding the two frameworks, the IO-PS framework and LDEF, was discussed.

Chapter 3 – Methodology

The purpose of this chapter is to give an overview of the application of the two frameworks. Firstly, the process followed to apply the IO-PS framework by describing how the value chain is built, how the IO-PS framework is applied and how the framework's output will be analysed. Secondly, the steps set out by the LDEF framework are described by defining the four phases of the framework, which is setting the unit of analysis, market analysis, location analysis and interaction dynamic analysis.

Chapter 4 – Input-Output Product Space analysis

This chapter describes the IO-PS framework's application by discussing the IO-PS variables used for analysis and analysing the generic automotive value chain and South African automotive value chain on tier and category level. Further analysis included comparing the output of the South African IO-PS with the output from Brazil and Thailand. Finally, the IO-PS was analysed on the product level, and an activity for further development was identified. The activity identified is the manufacture of automotive body parts.

Chapter 5 – Location Determinants Evaluation Framework

This chapter focuses on applying the LDEF framework to the activity defined by analysing the IO-PS output. This is done by firstly gathering information by using desktop research, developing interview questions and conducting interviews. Secondly, the unit of analysis was set by defining the global and local body parts industry. Thirdly, the market for body parts was analysed by defining the market, defining the market requirement, determining location factors that influence static market determinants and defining dynamic market factors. Fourthly, a location analysis was conducted by determining key location determinants that influence activity-related performance, defining the moderating factors and the dynamic location success factors. Finally, interaction and dynamic analysis were carried out by discussing the interaction moderator dynamics. Concluding chapter five, the last section comments on the policy implications deduced from the framework.

Chapter 6 – Discussions of frameworks

This chapter is dedicated to evaluating the use of the frameworks separately and also the use of the frameworks together to support the development of policies.

Chapter 7 – Conclusion and recommendations

The last chapter gives a document summary, an overview of how the thesis structure supports attaining the research aim, and recommendations for future work.

This chapter gave a summary of the chapters to give an overview of the thesis. In the following section, the application of these chapters to achieve the research aim will be discussed.

7.2 Achieving the research aim

The research aim, as stated in Section 1.2.2, was developed to address the need for supported decision-making in the policymaking process:

The primary aim of the research was to evaluate the use of the IO-PS framework (Bam and De Bruyne, 2019) and LDEF (Bam, De Bruyne and Schutte, 2020) as decision-support tools for developing policies for industrial sectors in general and the automotive industry in South Africa in particular.

In order to fulfil the aim, it was necessary to apply the IO-PS framework to the South African automotive industry and use the output from the IO-PS framework to apply the LDEF. The chapters and sections in this study supported attaining the aim and objectives (Table 7-1). Firstly it was necessary to set the background to support applying the frameworks in Section 2.1 to 2.3. The application of the IO-PS required literature research on the IO-PS (discussed in Section 2.4), describing the methodology used to apply the IO-PS framework (discussed in Section 3.1) and analysing the output of the framework (discussed in Chapter 4). The application of the LDEF required literature research on the framework (discussed in Section 2.5), describing the methodology used to apply the LDEF (discussed in Section 3.2) and applying the framework (discussed in Chapter 5). Finally, there was a need to evaluate the use of the frameworks as a policy decision support tool. Therefore, the methodology to evaluate the framework (Section 3.3), applying the IO-PS (Section 6.1) and LDEF (Section 6.2) and applying the frameworks together (Section 6.3) was discussed.

Table 7-1 How the chapters in this study support attaining the objectives

		Section
Introduction	✓ Background and Rationale	**1.1**
	✓ Research design	**1.2**
	✓ Case study selection	**1.3**
	✓ Ethical approval	**1.4**
Setting the background to support the application of the frameworks	✓ Literature research: Global automotive industry	**2.1**
	✓ Literature research: South African automotive industry	**2.2**
	✓ Literature research: Global automotive value chain	**2.3**
Objective 1: Apply the IO-PS framework	✓ Literature research on the IO-PS framework	**2.4**
	✓ The methodology used to apply the IO-PS framework	**3.1**
	✓ Analysis of the IO-PS framework output	**4**
Objective 2: Apply the LDEF	✓ Literature research on the LDEF	**2.5**
	✓ The methodology used to apply the LDEF	**3.2**
	✓ Application of the phases of the LDEF	**5**
Research Aim: Evaluate the application of the IO-PS and LDEF as decision support tools	✓ Methodology used to evaluate the frameworks	**3.3**
	✓ Evaluate the application of the IO-PS framework	**6.1**
	✓ Evaluate of the application of the LEDF	**6.2**
	✓ Evaluate the use of the frameworks together	**6.3**
Conclusion and recommendations	✓ Document summary	**7.1**
	✓ Achieving the research aim	**7.2**
	✓ Recommendations for future work	**7.3**

7.3 Recommendations for future work

Concluding this study, the following potential for future work are identified:

1. **Apply the LDEF to other activities from the automotive value chain**
   The activity chosen from the IO-PS framework was automotive body parts, but other activities also show opportunities for economic growth regarding their complexity and opportunity gain values. Applying the LDEF to more activities should confirm that the outcome of the LDEF gave a thorough overall understanding of the location success factors for the automotive stakeholders in South Africa.

2. **Apply the frameworks to EEV value chains**
   In the current 2017 trade data, EEVs and new technology automotive components are recorded under different HS Codes because the HS codes for the latest technologies have not yet been defined. It is recommended that an EEV value chain is built by consolidating the different trade codes used for EEVs and applying the IO-PS to this value chain. This could give valuable insight into which EEV direction is most optimal for South Africa.

3. **Determine if there is a viable case for small body parts**
   The information on small body part manufacturers is limited in South Africa because small body parts are mostly imported. Therefore, there could be possible opportunities for South Africa to manufacture small body parts locally. It is suggested that global small body part manufacturers are interviewed to fully understand the industry for small body parts and identify where possible opportunities for South Africa lie.

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Appendix A – Ethical clearance

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NOTICE OF APPROVAL

REC: Social, Behavioural and Education Research (SBER) - Initial Application Form

11 August 2020

Project number: 15526

Project Title: Policy decision-making: Rating South Africa as a location for automotive component manufacturers

Dear Mrs Mare Laing

Your REC: Social, Behavioural and Education Research (SBER) - Initial Application Form submitted on 30 July 2020 was reviewed and approved by the REC: Social, Behavioural and Education Research (REC: SBE).

Please note below expiration date of this approved submission:

Ethics approval period:

Protocol approval date (Humanities)	Protocol expiration date (Humanities)
11 August 2020	10 August 2023

Principal Investigator Responsibilities

Protection of Human Research Participants

As soon as Research Ethics Committee approval is confirmed by the REC, the principal investigator (PI) is responsible for the following:

Conducting the Research: The PI is responsible for making sure that the research is conducted according to the REC-approved research protocol. The PI is jointly responsible for the conduct of co-investigators and any research staff involved with this research. The PI must ensure that the research is conducted according to the recognised standards of their research field/discipline and according to the principles and standards of ethical research and responsible research conduct.

Participant Enrolment: The PI may not recruit or enrol participants unless the protocol for recruitment is approved by the REC. Recruitment and data collection activities must cease after the expiration date of REC approval. All recruitment materials must be approved by the REC prior to their use.

Informed Consent: The PI is responsible for obtaining and documenting affirmative informed consent using only the REC-approved consent documents/process, and for ensuring that no participants are involved in research prior to obtaining their affirmative informed consent. The PI must give all participants copies of the signed informed consent documents, where required. The PI must keep the originals in a secured, REC-approved location for at least five (5) years after the research is complete.

Continuing Review: The REC must review and approve all REC-approved research proposals at intervals appropriate to the degree of risk but not less than once per year. There is no grace period. Prior to the date on which the REC approval of the research expires, it is the PI's responsibility to submit the progress report in a timely fashion to ensure a lapse in REC approval does not occur. Once REC approval of your research lapses, all research activities must cease, and contact must be made with the REC immediately.

Amendments and Changes: Any planned changes to any aspect of the research (such as research design, procedures, participant population, informed consent document, instruments, surveys or recruiting material, etc.), must be submitted to the REC for review and approval before implementation. Amendments may not be initiated without first obtaining written REC approval. The only exception is when it is necessary to eliminate apparent immediate hazards to participants and the REC should be immediately informed of this necessity.

Adverse or Unanticipated Events: Any serious adverse events, participant complaints, and all unanticipated problems that involve risks to participants or others, as well as any research-related injuries, occurring at this institution or at other performance sites must be reported to the REC within five (5) days of discovery of the incident. The PI must also report any instances of serious or continuing problems, or non-compliance with the RECs requirements for protecting human research participants.

Research Record Keeping: The PI must keep the following research-related records, at a minimum, in a secure location for a minimum of five years: the REC approved research proposal and all amendments; all informed consent documents; recruiting materials; continuing review reports; adverse or unanticipated events; and all correspondence and approvals from the REC.

Provision of Counselling or emergency support: When a dedicated counsellor or a psychologist provides support to a participant without prior REC review and approval, to the extent permitted by law, such activities will not be recognised as research nor the data used in support of research. Such cases should be indicated in the progress report or final report.

Final reports: When the research is completed (no further participant enrolment, interactions or interventions), the PI must submit a Final Report to the REC to close the study.

On-Site Evaluations, Inspections, or Audits: If the researcher is notified that the research will be reviewed or audited by the sponsor or any other external agency or any internal group, the PI must inform the REC immediately of the impending audit/evaluation.

Appendix B – Electronic consent

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jou kennisvennoot • your knowledge partner

STELLENBOSCH UNIVERSITY

ELECTRONIC CONSENT TO PARTICIPATE IN RESEARCH

TITLE OF RESEARCH PROJECT:	Policy decision-making: Rating South Africa as a location for automotive component manufacturers
REFERENCE NUMBER:	ING-2020-15526
PRINCIPAL INVESTIGATOR:	Maré Laing
ADDRESS:	
CONTACT NUMBER:	
E-MAIL:	

Dear Prospective Participant

My name is Maré Laing, I am an M.Eng student at the Department of Industrial Engineering at Stellenbosch University and I would like to invite you to assist me with one facet of my research project.

Please take some time to read the information presented here, which will explain the details of this project contact me if you require further explanation or clarification of any aspect of the study. This study has been approved by the Research Ethics Committee (REC) at Stellenbosch University and will be conducted according to accepted and applicable national and international ethical guidelines and principles.

1. **INTRODUCTION:** The South African automotive industry is a key part of the country's manufacturing sector and assuming from the successes of industrial policy development programs and institutions the industry is dependent on industrial policies for some of its successes. Therefore, this study focuses on improved policy decision-making in the South African automotive component industry.
2. **PURPOSE:** The purpose of this study is to understand the performance factors which are perceived important for automotive body part manufacturers for success and to determine if South Africa is a viable location for body part manufacturing. The information obtained is aimed at policy decision-makers to have a better understanding of where to focus on policies for economic growth in the automotive industry in South Africa.
3. **PROCEDURES:** The study consists of survey questions and you will only be required to answer these questions
4. **TIME:** 30 minutes for the whole study

5. **RISKS:** There are no risks as no firm-specific information will be relayed.
6. **BENEFITS:** The results of the final project, which will give light as to how peers in your industry view South Africa as a location for automotive component manufacturing, which can be used for decision-making in your firm, will be communicated to you if you are interested. The results are also focused on policy decision-makers to support them in making decisions when making policies to ensure structural growth in the South African automotive industry.
7. **PARTICIPATION & WITHDRAWAL:** Your participation is entirely voluntary and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part. If you take part in the study and decide at any time that you do not want to take part anymore and exit the survey before clicking on the "Complete Survey" button all answers up to that point will be excluded from the survey.
8. **CONFIDENTIALITY:**
   - The information gathered during this interview/questionnaire will only be used for research purposes, specifically related to my thesis.
   - The prospective participant will not be requested to provide any personal information during the interview/questionnaire, which can identify them as an individual.
   - Contact information will only be known by the researcher, Maré, and your personal contact information will be kept confidential.
   - Any form of correspondence between prospective participants and investigators will be kept confidential, and only the principal investigator and his/her supervisor will have access to this information.
   - The identity of prospective participants will not be disclosed, the only personal data required is the participant's area of expertise.
   - The responses obtained during this survey will be assigned a unique reference number, which will be used to identify data in the thesis itself.
9. **DATA STORAGE:** Results obtained from this survey will be anonymised and will be stored by myself and my study leader on our authenticated Stellenbosch University OneDrive accounts for safekeeping.

If you have any questions or concerns about this research project, please feel free to contact If you have any questions or concerns about the research, please feel free to contact the researcher Maré Laing at +0000 and/or the Supervisor, Wouter Bam at + 0000

If you want a copy of this text, please don't hesitate to e-mail Maré Lain 000@sun.ac.za and a copy will be provided.

RIGHTS OF RESEARCH PARTICIPANTS: You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research subject, contact Ms Maléne Fouché(at the Division for Research Development. You have
the right to receive a copy of this Consent form.

If you are willing to participate in this research project, please select the relevant box in the Declaration of Consent below and send back to the investigator.

DECLARATION BY THE PARTICIPANT

As the **participant** I hereby declare that:

- I have read the above information and it is written in a language with which I am fluent and comfortable.
- I have had a chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in this study is voluntary and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- If the principal investigator feels that it is in my best interest, or if I do not follow the study plan as agreed to, then I may be asked to leave the study before it has finished.
- All issues related to privacy, and the confidentiality and use of the information I provide, have been explained to my satisfaction.

As the **participant** I hereby select the following option:

	I accept the invitation to participate in your research project, and if I decide to be interviewed it would automatically mean that I have given consent for my responses to be used confidentially and anonymously.
	I accept the invitation to participate in your research project, and if I decide to complete the questionnaire it would automatically mean that I have given consent for my responses to be used confidentially and anonymously.
	I decline the invitation to participate in your research project.

DECLARATION BY THE PRINCIPAL INVESTIGATOR

As the **principal investigator** I hereby declare that the information contained in this document has been thoroughly explained to the participant. I also declare that the participant has been encouraged (and has been given ample time) to ask any questions. In addition I would like to select the following option:

	The conversation with the participant was conducted in a language in which the participant is fluent.
	The conversation with the participant was conducted with the assistance of a translator, and this "Consent Form" is available to the participant in a language in which the participant is fluent.

______________________________ ______________________________

Signed at *(place)* **Date**

____

Signature of Principal Investigator

Appendix C – Results from desktop research: Location factors important for the automotive industry

Table C-1 Location factors important for the automotive industry

	Decision influencing location factor	Source
Cost		
Labour costs and productivity	•Salary costs •Production efficiency •Employer employee relationship •Labour unrest	Ubillos, 2008; PWC, 2018; Guzman, 2015; Alfaro et al., 2012;
Availability and cost of utilities	•Energy cost •Availability	Ubillos, 2008; PWC, 2018
Capacity changing and switching costs	•Production lost •Changes in patterns of demand from OEMs •Planning failures	Bennett and Klug, 2012; Naude, 2013; Barnes and Kaplinsky, 2000; Barnes and Morris, 2008; PWC, 2018
Industrial Land	•Physical land available in automotive industrial parks	Alfaro et al., 2012
Exchante rates/volatility	•A need for hedging exchange rate risks	Barnes and Kaplinsky, 2000; Guzman, 2015; PWC, 2018
Infrastructure	• Administrative infrastructure (government processes) •Technology centers and engineering firms •Information flows •State of the art technology •Technological integration	Bennett and Klug, 2012; Naude, 2013; Barnes and Kaplinsky, 2000; Deloitte, 2018
Institutions and trust	•Collaboration between OEMs and suppliers •Mitigate risk in emerging countries •Joint ventures preferred	Schmitt and Van Biesebroeck, 2013; Bennett and Klug, 2012; Naude, 2013; Barnes and Kaplinsky, 2000; PWC, 2018; Deloitte, 2018
Managerial skills/skills availability	•Education of workforce in automotive industry •Scientists and engineers required	Paulo, Fusco and Spring, 2003; Ubillos, 2008; Barnes and Morris, 2008; Deloitte, 2018; Alfaro et al., 2012
Natural hazards based on geography	•Production interruption (war, environmental. Terrorist)	PWC, 2018
Nearness and quality of material inputs and suppliers	•Special Economic Zones •Proper suppliers: quality, reliability, technological innovation, value for money •Quality and cost of raw materials (volatile) •Delivery reliability of suppliers •Working capital cost of raw material imports	Barnes and Morris, 2008; Barnes and Kaplinsky, 2000; Deloitte, 2018; Alfaro et al., 2012; Bennett and Klug, 2012; Naude, 2013; PWC, 2018
Tax structures	•Regulation risk	PWC, 2018; Ubillos, 2008
Trade protection	•Protection of local suppliers	Barnes and Kaplinsky, 2000; PWC, 2018; Deloitte, 2018; Alfaro et al., 2012
Transport costs	•Delivery reliability •Infrastructure •Quality	Schmitt and Van Biesebroeck, 2013; Bennett and Klug, 2012; Naude, 2013; Barnes and Kaplinsky, 2000; Ubillos, 2008; Barnes and Morris, 2008; Alfaro et al., 2012
Lead time/Responsiveness	•Demand distance •JIT manufacturing	Schmitt and Van Biesebroeck, 2013; Naude, 2013); Barnes and Kaplinsky, 2000; Barnes and Morris, 2008; Bennett and Klug, 2012
Market		
High levels of competition to supply OEM	•High levels of competition to supply OEM •Firms competing for the same geographical market •Customer outsourcing choices	PWC, 2018
Global economy and local economies	•Market fluctuations due to GDP, interest rates, fuel prices, etc.	PWC, 2018
Customer development	•Effects of models released by OEMs	PWC, 2018
Demand distance	•Proximity to OEM (cost)	Schmitt and Van Biesebroeck, 2013; Naude, 2013
Market access	•Potential large emerging markets •Strong domestic market •Unemployment •Revenue potential •Adaptions for domestic market	Bennett and Klug, 2012; Paulo, Fusco and Spring, 2003; Alfaro et al., 2012; Naude, 2013; Barnes and Kaplinsky, 2000
Good capital/financial market	•Access to credit •Ability to invest	Naude, 2013; Alfaro et al., 2012; PWC, 2018
Flexibility		
Contracting environment	•Contractual flexibility for workers	Ubillos, 2008
Moderating factors		
Economies of scale	•If economies of scale possible there exists a need for efficient logistic structure •Issue of proximity to customer versus ability to achieve economies of scale	Schmitt and Van Biesebroeck, 2013; Bennett and Klug, 2012; Barnes and Kaplinsky, 2000; Deloitte, 2018
Knowledge spillovers	•Proximity and exchange of knowledge •Cross-industry value chains	Schmitt and Van Biesebroeck, 2013; Bennett and Klug, 2012; Naude, 2013; Barnes and Kaplinsky, 2000; Deloitte, 2018
Resource intensity	•Resources determining location decisions	Barnes and Kaplinsky, 2000
Policy Environment		
Incentives, grants and subsidies	•Incentive systems (duty drawbacks) •Structural reforms	Barnes and Kaplinsky, 2000; Deloitte, 2018
Political and social tension	•Industrial disputes	Ubillos, 2008; PWC, 2018
Economic Environment		
Economic environment	•Macro economic situation	Naude, 2013; Alfaro et al., 2012; PWC, 2018
Quality		
Product quality	•Availability of quality components	Naude, 2013; Barnes and Kaplinsky, 2000; Barnes and Morris, 2008;
Cost of relocation	•Disinvestment	Ubillos, 2008; Schmitt and Van Biesebroeck, 2013
Product development		
Innovation capabilities	•Investment in R&D	Barnes and Kaplinsky, 2000; Barnes and Morris, 2008

Appendix D – Developing questions for the questionnaire

Table D-1 Table for developing interview questions

	Phase 0 0.1 Activity Definition			EXPECTED ANSWER/REPLY NEEDED
SURVEY	**Dynamism of product market environment**			
How often does the market change/require the firm to make changes - knowldegeable supporting firms become more important - What do they need from SA as location?		**How dynamic is the product market environment**		Impact
		- Changes in patterns of demand from OEM		Demand Planning skills/Management - reduce overruns, reduce waste/Technology Development
		- Frequency of models released		-Quick changeover - customer requirement -Flexibility/Responsiveness -Automation -Skills Availability
SURVEY	**Knowledge spilled over** (Literature: Knowledge Spillover Effects:Impact of Export LearningEffects on Companies' InnovativeActivities)			
What is important for knowledge spillover/How does	**How important are the following for knowledge spillover for the firm/activity?**			
	If supplier doesn't supply to OEMs this will not apply.	How important is Proximity to OEMs for knowledge sharing?	1 - Irrelevant; 2 - Of little importance; 3 Of average importance; 4 - Very important; 5 - Absolutely essential	Proximity to OEMs
		How important are Cross-industry Value chains for knowledge sharing?	1 - Irrelevant; 2 - Of little importance; 3 Of average importance; 4 - Very important; 5 - Absolutely essential	Improved social structures and institutions that promote knowledge sharing
		How important are Industrial Parks/Special Economic Zones/Clusters for knowledge	1 - Irrelevant; 2 - Of little importance; 3 Of average importance; 4 - Very important; 5 - Absolutely essential	Improved social structures and institutions that promote knowledge sharing
		How important is it to have Competitors in the area for knowledge sharing?	1 - Irrelevant; 2 - Of little importance; 3 Of average importance; 4 - Very important; 5 - Absolutely essential	Improved social structures and institutions that promote knowledge sharing
	If supplier doesn't supply to OEMs this will not apply.	How important is proximity to OEM R&D centers for knowledge sharing?	1 - Irrelevant; 2 - Of little importance; 3 Of average importance; 4 - Very important; 5 - Absolutely essential	Improved social structures and institutions that promote knowledge sharing
	If Above is greater equal 3	Would proximity to OEM R&D be less important if systems integration/telecommunications are updated?	Yes/No Comment	Infrastructure
	If supplier doesn't supply to OEMs this will not apply.	How important is systems integration with OEM for knowledge sharing?	1 - Irrelevant; 2 - Of little importance; 3 Of average importance; 4 - Very important; 5 - Absolutely essential	Systems Integration
SURVEY	**Maturity of product - Industry driven by customer needs or science**			
Cost vs Technology advances		Maturity of product	Introductory Stage/Growth Stage/Maturity Stage/Decline Stage	The focus for more mature products is on manufacturing costs instead of science
SURVEY	**Economies of Scale**			
Are economies of scale necessary to make manufacturing viable - Viable in SA?		Are economies of scale **needed** for different models to make manufaturing viable?	Yes/No - Comment	Cost implications: Customer requirement; offering; market access
		Are economies of scale possible in South Africa? e.g. is the market for the output big enough? / do you have the technology for EOS?	Yes/No - Options/N/A - EOS not needed Demand for models aren't high enough; Do not have the technology for EOS; other - comment	Technology development Market access/Size of market - Competitiveness in the market
SURVEY	**Transportability of output from activity**			
-Understand the output -How important is it to be close to customers for optimal logistics -Are different parts easier to transport?		How important is proximity to OEMs for transport (i.e. optimal logistics) of output?	1 - Irrelevant; 2 - Of little importance; 3 Of average importance; 4 - Very important; 5 - Absolutely essential	
		Does the transportability for different body parts manufactured at your plant differ?	Yes/No - Comment (if yes)	

ANALYSIS	**How easy is measuring output from activity**			
Measuring output: What is the confidence level needed from customers? (e.g. airbags cannot be tested easily)		Quality is important if customer is far- reliability the location implication for quality is skills availability, tech advance		
	0.2 Firm Definition			
RESEARCH	**Existing global footprint**			
		Firm HQ location	Comment section	Research
		Locations of firm (plants)	Comment section	
		Locations of firm (plants) in South Africa	Comment section	
		Size of firm - number of employees	Comment section	
SURVEY	**Experience in different regions**			
		Different experience in different regions in South Africa	Yes/No/N/A - Comment (if yes)	Understand the overall experience of firms in different regions in SA
SURVEY	**Lifecycle stage of firm**			
		In which lifecylce stage is the firm?	Development/Startup/Growth/Expansion/Maturity	
SURVEY	**Interdependance between different functions in firm**			
		Are different functions in order to deliver the final product performed at different locations?	Yes/No	
SURVEY	**Automation (Industry 4.0)**			
Understand if it is important to be close to customer for system integration If the industry is expected to move towards automation, skills development will be important	-Extent of automation of manufacturing processes*	1 - mostly manual operations; 5 - highly automated machine tools		Skills Development (sien 0.1.1) Process risk
	-Extent of adoption of process automation programs (next 3 years) **	Extent of adoption of process automation programs (1 none; 5 - high)		Skills Development Investment in technology Process risk
	If* option smaller equal 3: Why?	1 - Cost of automation high 2 - Limited access to R&D 3 - Limited time 4 - Not important at this time 5- Other: Comment		Understand why no/low automation - Get an idea where company lacks and might need support
	If** option smaller equal 3: Why?	1 - Cost of automation high 2 - Limited access to R&D 3 - Limited time 4 - Not important at this time 5- Other: Comment		Understand why no/low automation - Get an idea where company lacks and might need support
	How important is systems integration with OEM for success of budsiness	1 - Irrelevant; 2 - Of little importance; 3 Of average importance; 4 - Very important; 5 - Absolutely essential		Skills Development Technological capabilities Process risk
	Do you have access to R&D centers for alternative material development, alternative manufacturing processes,	Yes/No - Comment		Process risk
	Cost of technology development (e.g. automation, systems integration, etc) in South Africa?	1 - Very Low; 2 - Low; 3 - Average; 4 - High; 5 - Very High		Technology Development Infrastructure Process risk

	Phase 1: Market Ananlysis **1.1 Market Definition**				
SURVEY	**Market position of firm**				
	Components	Which vehicle body components produced by the firm?	Bumpers/Valance panel/Inner Fender/Fender/Cowl panel/Door/Lower Door Skin/Rocker Panel/Dogleg/Wheel Arch Panel/Wheelhouse/Quarter Panel/Fender extension panel/Header panel/Hood/Firewall/Truck OR Other		
	Exported	Which of these products are typically exported?	Bumpers/Valance panel/Inner Fender/Fender/Cowl panel/Door/Lower Door Skin/Rocker Panel/Dogleg/Wheel Arch Panel/Wheelhouse/Quarter Panel/Fender extension panel/Header panel/Hood/Firewall/Truck OR N/A		
	Vehicle type	Choose type of Passenger vehicles:	Hatchback cars/ Sedans/Multi-purpose vehicles/Sport utility vehicles OR Other		
	Tier	State tier of firm in the industry	First tier/Second tier/Other		
	End-User/Customer	End-user/customer of firm (can choose more than one)	OEM (In SA)/Aftermarket/Africa Aftermarket/International OEM/Other - specify	Dependance	
RESEARCH	**African Component Market**				
	1. Component exoprt to Africa from South Africa				
	2. African component imports excluding South Africa				
	3. Africa car imports excluding South Africa				
RESEARCH	**OEM component market in South Africa**				
	1. Passenger car sales in South Africa				
	2. Passenger car sales in Africa				
	3. Component imports for OEM				
	4. Number of OEMs in South Africa				
RESEARCH	**Aftermarket**				
	1. Aftermarket sales of component in South Africa				
	2. Imports of component for aftermarket				
RESEARCH	**Global Market**				
	1.Top importers of component from South Africa				
	2.Top importers of component excluding South Africa				
	3. Top importers of passenger vehicles from South Africa				
	4. Top importers of passenger vehicles excluding South Africa				
RESEARCH	**Trade Barriers in place to protect local component production - Market Access**				

	1.2 Market Requirement		
SURVEY	**Rate the importance of the following key requirements for performance of a typical firm in the industry**		
	Cost	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very Important	
	Lead time	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very Important	
	Flexibility	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very Important	
	Reliability	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very Important	
	Responsiveness	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very Important	
	Quality	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very Important	
	Sustainability (environmental and social)	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very Important	
SURVEY	**Rate South Africa's performance in comparison with global competitors with regard to the following key requirements**		
	Cost	1 - Much worse; 2 - Worse; 3 - The same; 4 - Better; 5 - Much Better	
	Lead time	1 - Much worse; 2 - Worse; 3 - The same; 4 - Better; 5 - Much Better	
	Flexibility	1 - Much worse; 2 - Worse; 3 - The same; 4 - Better; 5 - Much Better	
	Reliability	1 - Much worse; 2 - Worse; 3 - The same; 4 - Better; 5 - Much Better	
	Responsiveness	1 - Much worse; 2 - Worse; 3 - The same; 4 - Better; 5 - Much Better	
	Quality	1 - Much worse; 2 - Worse; 3 - The same; 4 - Better; 5 - Much Better	
	Sustainability (environmental and social)	1 - Much worse; 2 - Worse; 3 - The same; 4 - Better; 5 - Much Better	
SURVEY	**Rate South Africa's anticipated 3 year performance with regard to the following key requirements**		
	Cost	1 - Very Poor; 2 - Poor; 3 - Acceptable; 4 - Good; 5 - Very Good	
	Lead time	1 - Very Poor; 2 - Poor; 3 - Acceptable; 4 - Good; 5 - Very Good	
	Flexibility	1 - Very Poor; 2 - Poor; 3 - Acceptable; 4 - Good; 5 - Very Good	
	Reliability	1 - Very Poor; 2 - Poor; 3 - Acceptable; 4 - Good; 5 - Very Good	
	Responsiveness	1 - Very Poor; 2 - Poor; 3 - Acceptable; 4 - Good; 5 - Very Good	
	Quality	1 - Very Poor; 2 - Poor; 3 - Acceptable; 4 - Good; 5 - Very Good	
	Sustainability (environmental and social)	1 - Very Poor; 2 - Poor; 3 - Acceptable; 4 - Good; 5 - Very Good	
	1.3 Static Market Determinants		
	Geo-Political Situation		
	How important is government relationship for the success of the industry in SA?	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very Important	Improved social structures and institutions that promote knowledge sharing - Dubbele vraag 1.3.1
	How important is government intervention for the success of the industry in SA? (unions)	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very Important	Improved social structures and institutions that promote knowledge sharing - Dubbele vraag 1.3.1
	How important is subsidies, grants, incentives for the success of the firm?	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very Important	
	Geography		
SURVEY	How important is access to African markets for success of firm?	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very Important	
	Tastes of local customer		
	Do the body styles differ for SA in comparison with international styles?	Yes/No (Comment if Yes)	Small market/cost effectiveness/cannot export
	Does the lack of a relationship with an OEM make entry to market more difficult?	Yes/No (Comment if Yes)	

	Phase 2: Location Analysis **2.1 Static Performance Determinants**				
SURVEY	Cost of skilled employees	1 - Very Low; 2 - Low; 3 - Average; 4 - High; 5 - Very High			
	Cost of low skill level employees	1 - Very Low; 2 - Low; 3 - Average; 4 - High; 5 - Very High			
	Cost of skill development in SA	1 - Very Low; 2 - Low; 3 - Average; 4 - High; 5 - Very High			
	Rate telecommunications in SA (cost/quality)	1 - Very Low; 2 - Low; 3 - Average; 4 - High; 5 - Very High			
SURVEY	**Skills level**				
Understand the skills needed for the activity	Can the skills needed for different job levels be acquired in South Africa? (e.g. is it more difficult to get labour for higher skilled jobs)	Yes/No - Comment section	Can they find the necessary skills in SA or do they need to import skill i.e. does SA need more skills development?/ Different skill levels, different availability	Skills Development Supplier development Competitiveness in Labour market	
	Reasons for using international employees	Management Skills/Technological skills/Knowledge sharing/other - comment/Don't use international employees	Understand if imported employees for skills (manegerial/ engineering expers) understand if expert knowledge/ management skills are lacking etc.	Skills Development Supplier Development Skills experience needed	
	Phase 3: Interaction and dynamic analysis **3.1 Market Dynamics**				
	How important are the following market dynamics in terms of location for future market access				
	Migration/Firm relocation				
	What will the extent of the effect be if OEMs relocate to different parts of the world?	1 - Little to no effect; 2 - Small effect; 3 - Moderate; 4 - Big effect; 5 - Great effect		1.1.1 Market Definition - Definition/who customer is will suggest the effect of relocation of OEMs	
	How important are relocation of OEMs to South Africa for the success of the business?	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very High			
SURVEY	What is the effect of direct competitors relocating to South Africa?	1 - Little to no effect; 2 - Small effect; 3 - Moderate; 4 - Big effect; 5 - Great effect		Are the market currently very competitive? How easy is it to source raw materials?/Quality	
	Sophistication of customer in market				
	What will the extent of the effect of environmental considerations be on the market for body parts in the next 5 years?	1 - Little to no impact; 2 - Small impact; 3 - Moderate; 4 - Big impact; 5 - Great impact			
	Market segment taste changes				
	Alternative materials risk	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very High			
	How important is the relationship with OEMs for the success of the firm?	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very Important		Improved social structures and institutions that promote knowledge sharing	
	Economic Development				
	Do most of the firms industry have access to Special Economic Zones?	Yes/No - Comment			
	How difficult is it to get access to Special Economic Zones?				
	Is being part of Special Economic Zone required for success in South Africa?				

	3.2 Location Dynamics				
	To what extend does the following impact when making investment decisions in South Africa				
	Exchange rate volatility	1 - Little to no impact (it was not considered at all) ; 2 - Small impact (Only mentioned) ; 3 - Moderate (Mentioned and discussed); 4 - Big impact (Changes were made to investment due to this); 5 - Great impact (decided NOT to invest due to this)			
	Threat of expropriation	1 - Little to no impact (it was not considered at all) ; 2 - Small impact (Only mentioned) ; 3 - Moderate (Mentioned and discussed); 4 - Big impact (Changes were made to investment due to this); 5 - Great impact (decided NOT to invest due to this)			
	Political risk/unstability	1 - Little to no impact (it was not considered at all) ; 2 - Small impact (Only mentioned) ; 3 - Moderate (Mentioned and discussed); 4 - Big impact (Changes were made to investment due to this); 5 - Great impact (decided NOT to invest due to this)			
	Economic stability (incl. inflation)	1 - Little to no impact (it was not considered at all) ; 2 - Small impact (Only mentioned) ; 3 - Moderate (Mentioned and discussed); 4 - Big impact (Changes were made to investment due to this); 5 - Great impact (decided NOT to invest due to this)			

	3.3 Market-location interaction			
	When considering South Africa as a location how important are the following			
	Transportation costs			
	How important is a constant logistics market (if supplier is close to customer this should not be of high importance)	- How far is Head office from firm (0.2.1) - Exports by firm (1.1.1) - Exports by industry (Research)		
	Interaction costs			
	Logistic Infrastructure investment by government (if supplier is close to customer this should not be of high importance)	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very Important		
	The ease of travelling for work/immigration from HQ	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very Important		
	Political factors			
	Political instability	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very Important		
	Policies and strategies put in place by government and institutions are aligned and monitored	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very Important	Improved social structures and institutions that promote knowledge sharing Legal risk Institutions and trust	
	Political and social tensions: Relationship with unions and government	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very Important	Improved social structures and institutions that promote knowledge sharing - Dubbele vraag 1.3.1 Institutions and trust	
	Trade Barriers - Market access			
	How important is the protection of local component manufacturers by government, in the form of trade protection, for success of firm in South Africa?	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very Important		
	How important is access to African markets for success of business	1 - Not Important; 2 - Slightly Important; 3 - Moderately Important; 4 - Important; 5 - Very Important		

Appendix E – Questionnaire

Survey: Policy decision-making: Rating South Africa as a location for automotive component manufacturers

1. Body Parts Industry South Africa

1.1 Demand for body parts

Changes in patterns of demand from OEM

1 - Never (Demand is constant);
2 - Very Rarely;
3 - Occasionally;
4 - Frequently;
5 - Very frequently

Frequency of tooling upgrades due to new models released

1 - Changes every 6-8 years
2 - Changes every 3-5 years
3 - Changes every 1-2 years

1.2 Economies of scale

Are economies of scale needed to make manufacturing of body parts in South Africa viable?
Yes/No – Please comment

Are economies of scale possible in South Africa? (e.g. is the market for the output big enough? / why can't you reach economies of scale in South Africa?)
Yes/No – Please comment

2. Industry Definition – Body Parts Manufacturing Industry

2.1 Experience in different regions

Does the industry have different experiences in terms of different regions (i.e. skills or raw material availability, ease of doing business, etc.)?
Yes/No - Comment (if yes)

2.3 Interdependence between different functions in the firm

Are different functions to deliver the final product for the typical firm performed at different locations?

Yes/No - Comment (if yes)

2.4 Automation

The extent of automation of manufacturing processes in the industry*

1 – all processes are manual
2 – some automated, but mostly manual
3 – manual/automated processes are equal
4 – some manual, but mostly automated
5 – fully automated processes

The industry automation planned for the next 3 years **

1 – none
2 – some processes will be automated
3 – half of the processes will be automated
4 – most processes will be automated
5 – all processes will be automated

If * option smaller equal 3: Why?

1 Cost of automation high
2 Limited access to R&D
3 Limited time
4 Not important at this time (i.e. not required by OEM)
5 Other: Comment

If ** option smaller equal 3: Why?

1 Cost of automation high
2 Limited access to R&D
3 Limited time
4 Not important at this time (i.e. not required by OEM)
5 Other: Comment

How vital is systems integration with OEMs for the success of the industry?

1 - Irrelevant;
2 - Of little importance;
3 - Of average importance;
4 - Very important;
5 - Absolutely essential

Cost of technology development (e.g. automation, systems integration, etc.) in South Africa in comparison with the rest of the world?

1 - Very Low
2 - Low
3 - Average
4 - High
5 - Very High

2.5 What is considered important for knowledge spillovers for the industry?

- ☐ Proximity to OEMs
- ☐ Cross-industry Value chains
- ☐ Industrial parks/Special Economic Zones/Clusters
- ☐ Proximity to Competitors
- ☐ Proximity to OEM R&D
- ☐ Systems integration with OEM

3. Market Definition

3.1 Market position of the typical firm in the body parts manufacturing industry

Who is typically the customer of body part manufacturers?

- ☐ OEM (located in SA)
- ☐ Aftermarket
- ☐ Africa Aftermarket
- ☐ OEM (international location)
- ☐ Other – please specify

4. Static Performance Determinants

5.1 Skills cost and availability in the industry

Cost of skills development in the industry in South Africa

1 - Very Low
2 - Low
3 - Average
4 - High
5 - Very High

Can the skills need for different job levels be acquired in South Africa? (e.g. is it more challenging to get the labour for higher-skilled jobs)

Yes/No - Comment section

Reasons for using international employees in the industry in South Africa

Management Skills/Technological skills (e.g. experience with tooling)/Knowledge sharing/other - comment/N/A

5. Market Dynamics

What will the impact of environmental considerations be on the market for body parts in the next 5 years?

1 - Little to no impact
2 - Small impact
3 - Moderate
4 - Big impact
5 - Great impact

How big is the risk for the use of alternative materials in the industry?

1 - Very Low
2 - Low
3 - Average
4 - High
5 - Very High

Do most of the firms in the industry have access to Special Economic Zones?

Yes/No – Comment

How difficult is it to get access to Special Economic Zones?

1 – Very easy
2 – Easy
3 – Average
4 – Difficult
5 – Very Difficult

6. Location dynamics

Have any of the following considerably influenced decision-making in terms of doing business or developing the industry in South Africa? (Choose one or more)

- ☐ Exchange rate volatility
- ☐ Threat of expropriation
- ☐ Political risk or instability
- ☐ Regulation
- ☐ Bureaucratic risk
- ☐ Economic stability
- ☐ Risk of strikes
- ☐ Infrastructure – Telecommunications

7. Market-location interaction

How vital from 1 to 5 (1 – irrelevant to 5 absolutely essential) is the following for the success of the industry in South Africa?

	Importance (1 to 5)				
Supplier development (services and raw materials)	1	2	3	4	5
Access to African markets	1	2	3	4	5
Protection of local component manufacturers	1	2	3	4	5
Relationships with unions/government	1	2	3	4	5
Special economic zones	1	2	3	4	5
Relationship with OEMs	1	2	3	4	5
Access to R&D centers	1	2	3	4	5

8.3 Access to raw materials

How easy is accessing raw materials in South Africa?

1 – Very easy
2 – Easy
3 – Average
4 – Difficult
5 – Very Difficult

How does the cost of raw materials in South Africa compare to the rest of the world?

1 - Very Low
2 - Low
3 - Average
4 - High
5 - Very High

Appendix F – Body parts for BIW

Table F-1 Body parts used in the assembly of BIW (Source: Klinger, 2012)

Body parts according to lower-, upper- and side structure of BIW				
Body Lower Structure (1)	**Body Lower Structure (2)**	**Body Lower Structure (3)**	**Body Upper Structure**	**Body Side Structure**
Rear Rail LH	Upper Rad Support RH	Rear Reinf Package Tray	Bond Beam	Panel - Body Side Outer RH
Rear Rail LH	Lower Rad Support LH	Shock Tower LH	Roof Bow	Rocker RH
Rear Rail RH	Lower Rad Support RH	Shock Tower RH	Bracket - Bow LH	FBHP RH
Floor Panel LH	Support Bracket LH	Tunnel Bulkhead Low	Bracket - Bow RH	Reinf - Roof Rail RH
Floor Panel RH	Support Bracket RH	Tunnel Bulkhead Upper	Bracket - Roof Header to Ra	Panel - Wheel House Outer RH
Cradle Mount Bracket LH	Radiator Support Upper Main	Tunnel Crossmember	Bracket - Roof Header to Ra	Panel - Wheel House Inner RH
Cradle Mount Bracket RH	Radiator Support Low	Engine Mount Upper RH	Rear Header	Reinf - B-Pillar RH
Support Bracket LH	Cowl Lower	Mount Frame - Suspension Cradle LH	Roof Header	Roof Rail Inner Front RH
Support Bracket RH	Cowl Inner	Mount Frame - Suspension Cradle RH	Panel - Roof	B-Pillar Inner RH
Rear Rail Reinforcement LH	Front Rail Brkt Center	Engine Mount Upper LH	Bracket - Center Overhead	Rocker Cover - Rear Door RH
Rear Rail Reinforcement RH	Cargo Floor	Bracket WH-PT Reinf LH	Bracket - Rear Header to Roof Rail LH	Rocker Cover - Front Door RH
Front Rail Tip LH	Back Panel Outer	Bracket WH-PT Reinf RH	Bracket - Rear Header to Roof Rail RH	Roof Rail Inner Rear RH
Front Rail Tip RH	Package Tray	Close-Off Tunnel Front LH	Roof Header Reinf	Lamp Can RH
Front Rail Lower LH	Tunnel Main	Close-Off Tunnel Front RH	Support Roof LH	Reinf - Package Tray RH
Front Rail Lower RH	Seat Pan Rea	Gutter Reinf LH	Support Roof RH	Rear Quarter Lower RH
Front Rail Lower to Rocker LH	Rear Crossmember	Gutter Reinf RH		
Front Rail Lower to Rocker RH	Dash Panel	Rear Rail Inr Brkt LH		
Front Rail Upper LH	Tunnel - Dash Interface Panel	Rear Rail Inr Brkt RH		
Front Rail Upper RH	Crossmember Rear Seat	Gas Tank Mount LH		
Close-Out Front Rail LH	Seat Crossmember Front LH	Gas Tank Mount RH		
Close-Out Front Rail RH	Seat Crossmember Front RH	Shotgun Inr LH		
Front Rail to Tunnel LH	Waterfall Panel	Shotgun Inr RH		
Front Rail to Tunnel RH	Side Panel Rear Seat LH	Hood Hinge Reinf LH		
Reinf - Engine Cradle Mount LH	Side Panel Rear Seat RH	Hood Hinge Reinf RH		
Reinf - Engine Cradle Mount RH	Cowl Upper	Shotgun Inr Brkt LH		
Bulkhead Rear Engine Cradle Mount	Front Seat Crossmember LH	Shotgun Inr Brkt RH		
Shotgun Outer LH	Front Seat Crossmember RH	Brkt Shotgun Inr Rear LH		
Shotgun Outer RH	Package Tray Crossmember	Brkt Shotgun Inr Rear RH		
Shotgun Inner LH	Back Panel Inr LH	Bracket Hood Damper LH		
Shotgun Inner RH	Back Panel Inr RH	Bracket Hood Damper RH		
Upper Rad Support LH	Back Panel Inr	Dash Reinf		

Appendix G – Comparison of SAAM and LDEF

Table G-1 Comparison of the SAAM vision with the output of the LDEF

Six pillars of the SAAM	Changes needed to reach the SAAM vision of the automotive industry in 2035	Changes required in the automotive industry highlighted by the location determinants framework
1. Location market optimisation	The growth of domestic market is tied directly to the state of the SA economy, economic growth rates and vehicle consumption are strongly correlated	• The body parts demanded are directly related to the demand for vehicles
	Local manufacturers need to capture more significant domestic market share	
	Domestic market optimisation using policy, there is a misalignment between local production and local consumption	
2. Regional Market Development	There is a need to establish a regional automotive development programme that operates to support the shared industrial development aspirations of SSA economies is therefore critical	• Increased demand from SSA would increase demand for vehicles which would improve economies of scale • South Africa is a unique location with regard to access to African markets
	Realisation of mutual benefits and partnerships between South African and Sub-Saharan governments and private and public sectors	
3. Localisation	Increasing local content through SA and regional value chain	
	Improve factor cost profile (overheads, labour, materials cost, productivity)	• Labour costs, productivity and availability and cost of utilities is of concern
	Having skills and technology available before it is demanded	
	Logistics costs and government-administered costs are high	
	Having global quality components and raw materials available in SA	• The quality raw materials required by OEMs for body parts cannot be aquired in SA, if it is locally available it is too expensive
	Targeted product specialisation and linking SA's material base to emerging opportunities (EEV's)	• Alternative material requirements are developed by OEMs and if it cannot be sourced locally it will be imported
	Specialisation of processes/products to attain economies of scale in order to become more competitive	
	Key is to identify opportunities for economies of scale, which is seen as a policy issue	
4. Automotive infrastructure development	Improvements to ensure world class logistical linkages and transport infrastructure	
	Efficient industrial parks	
	Flexible semi-skilled labour	• The skills levels required cannot be sourced in SA and skills need to be imported
	Advanced admin, artisan and professionally skilled labour	• The skills levels required cannot be sourced in SA and skills need to be imported
	Just in sequence OEM supply	
	Connectivity – transport and telecommunication	
	Advanced product testing and homologation centres	
	Market-related and emerging technology elements (advanced fuel)	
	Invest in alternative technology infrastructure to transition to EEV	• Raw material R&D for EEV
5. Industry transformation	Employee education and skills development	• The skills levels required cannot be sourced in SA and skills need to be imported
	Technical and advanced management skills	• The skills levels required cannot be sourced in SA and skills need to be imported
	Prioritise lower tier majority black-owned supplier development	
	Enterprise development support	
	Support to dealership network and authorised vehicle repair facilities	
6. Technology and associated skills development	There is a need for a technology and associated skills development roadmap	• Lower tier suppliers do not have the capital and expertise to develop products for a highly sophisticated industry
	EEV powertrain and drivetrain developments, safety technologies, material composites, infotainment technologies, nanotechnology, additive manufacturing, product recycling	• Raw material R&D for EEV
	Improved automotive material supply, aligning with new technologies associated with environmental requirements and advancing SA capabilities in terms of core materials, Platinum Group Metals, aluminium, certain grades of steel	• The quality raw materials required by OEMs for body parts cannot be aquired in SA, if it is locally available it is too expensive
	Demanding environmental requirements: South Africa needs to ensure local production comply to developed economies' requirements	